

Article

Securing the Future of Cultural Heritage by Identifying Barriers to and Strategizing Solutions for Preservation under Changing Climate Conditions

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Abstract: Climate change challenges cultural heritage management and preservation. Understanding the barriers that can impede preservation is of paramount importance, as is developing solutions that facilitate the planning and management of vulnerable cultural resources. Using online survey research, we elicited the opinions of diverse experts across southeastern United States, a region with cultural resources that are particularly vulnerable to flooding and erosion from storms and sea level rise. We asked experts to identify the greatest challenges facing cultural heritage policy and practice from coastal climate change threats, and to identify strategies and information needs to overcome those challenges. Using content analysis, we identified institutional, technical and financial barriers and needs. Findings revealed that the most salient barriers included the lack of processes and preservation guidelines for planning and implementing climate adaptation actions, as well as inadequate funding and limited knowledge about the intersection of climate change and cultural heritage. Experts perceived that principal needs to overcome identified barriers included increased research on climate adaptation strategies and impacts to cultural heritage characteristics from adaptation, as well as collaboration among diverse multi-level actors. This study can be used to set cultural heritage policy and research agendas at local, state, regional and national scales.

Keywords: needs assessment; climate change adaptation; cultural resource management; historic preservation

1. Introduction

Cultural heritage consists of non-renewable and irreplaceable resources, which represent the remains of our past and includes society's past investments of economic, physical, natural and intellectual resources [1,2]. Cultural heritage is either a tangible entity (e.g., archeological site, cultural landscape, historic district, historic site, historic building, historic structure, historic object) or cultural practice associated with a way of life (e.g., musical performance, craft production; [3]). Moreover, cultural heritage plays an important role in providing tourism and recreation opportunities, enhancing economic development and growth, stimulating education and learning, and fostering cultural identity and a sense of place [4,5].

In the United States, the National Park Service [6], which manages and preserves both nationally significant natural and cultural heritage, estimated that for every tax dollar invested into NPS there is a return of \$10 to the economy from spending in the tourism and recreation sectors. For example, the Statue of Liberty National Monument in New York City generated about \$263 million from visitor spending and supported a total of 3352 jobs in 2016 [6]. Yet, changing climate conditions (e.g., changes in temperature and precipitation patterns, rising sea levels and increasing frequency and intensity

of storms and hurricanes) are affecting cultural resource management [7,8] and the preservation of cultural values and the significance embodied in tangible cultural resources [9].

Maus [10] argues that our cultural human rights are being negatively affected by climate change through degradation and/or loss of cultural heritage. Although aspects and materials of cultural heritage have survived over the past centuries [11], it is likely that cultural heritage may experience more severe climate change impacts in the coming decades [12] and may not sustain management actions implemented to adapt to the previous types of impacts. Furthermore, research and policy guidance for managing cultural heritage under changing climate conditions has been incrementally increasing during the past decade e.g., [13–16]. Yet, more efforts for proactive adaptation planning is needed [17], particularly for heritage sites in coastal zones [18], to both reduce the vulnerabilities of cultural resources to climate change impacts and facilitate more rapid and efficient responses to climate impacts as they occur [19].

Climate change adaptation planning is a decision-making process that aims to moderate the harm or benefit from opportunities associated with current or potential future climate change impacts [12]. Within the context of cultural heritage adaptation, Heathcote et al. [20] described two types of adaptation strategies. The first is a set of low-risk strategies that focus on improving protection from changing climate conditions that are already happening, such as regular maintenance to ensure historic buildings are weather-proof. The second type are higher risk strategies, which require adjustment of practices or even changes to what cultural heritage management or historic preservation currently find acceptable, such as changes to historic buildings in areas of high flood risk making them more resilient to inundation and recovery. To design and implement transparent, acceptable and successful climate adaptation strategies, multi-level decision-making process is needed. This process can create collective action across multiple levels of government, non-governmental organizations, other public and private entities, and local communities [21–24]. Additionally, multi-level decision-making can enhance a better understanding of the different values, priorities, and risk perceptions, as well as support social learning and co-production of knowledge [9,23,24].

Nevertheless, in climate change adaptation processes, it is critically important to recognize and identify the barriers that can impede adaptation planning and the implementation of strategies [25,26]. Understanding barriers can increase the effectiveness of adaptation responses to current and potential future climatic changes, prioritize adaptation strategies, and prevent or minimize misallocated decision-making efforts, e.g., [26–28]. Importantly, barriers to cultural heritage adaptation or historic preservation globally have not been yet well understood [13].

This paper aims to identify and characterize perceived barriers hindering heritage preservation in the face of current and future climatic changes. We explicitly selected an emic approach to elicit and document the salient opinions of cultural resource and heritage preservation experts rather than impose the a priori ideas of our research team (etic approach; see [29] for a full discussion of emic versus etic research approaches). Additionally, this paper explores the interdependencies of barriers, as well as identifies policy and practice needs for overcoming the barriers identified. To simplify our presentation, we use the term “heritage preservation” to encompass the fields of cultural resource management and historic preservation, and refer to “cultural resources” or “cultural heritage” as the tangible, physical remains (e.g., historic and archeological buildings, structures and objects) located within “cultural landscapes” (e.g., historic and archeological districts and sites). Furthermore, we confined our study to the context of coastal climate change impacts within the southeastern region of the United States.

In this paper, we define vulnerability as the probability of losing significant cultural resources (and losses to the significance of cultural resources) from climate variability or change [9]. As such, a cultural resource’s vulnerability is characterized by its presence in a location that could be adversely affected by a climatic event (i.e., exposure) and the degree to which its significance could be affected by that exposure (i.e., sensitivity) [19]. To define significance, we adopt the criteria outlined for listing cultural resources in the National Register of Historic Places (NRHP), which specifies “the quality

of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association" [3]. The listing criteria further delineates significance as the association with an historical event, significant person, distinctive physical characteristics of design, construction or form, or a resource that holds or has the potential to yield important information in prehistory or history. Moreover, the NPS issued Policy Memorandum 14-02 [30] that explicitly states that vulnerability and significance must be evaluated so that management action is directed to cultural resources that are both significant and most at risk from climate change.

Barriers to Heritage Preservation and Climate Adaptation

Barriers are obstacles, constraints, or hurdles that impede climate adaptation or make adaptation impossible to achieve [12,23,26]. In climate change contexts, barriers arise due to characteristics of the individuals involved, the nature of the systems involved, and the larger context within which the individuals and systems operate [28]. Barriers can prevent building adaptive capacity, hinder implementation of adaptation measures, slow down the uptake of adaptation in policy, lead to policy failure, constrain individual engagement or action, or prevent the uptake of new frameworks and tools to support adaptation [12,25]. Matasci et al. [31] document that barriers arise at all phases of the adaptation process, including recognizing climate change impacts, undergoing adaptation planning, deciding to act, and implementing adaptation strategies. Additionally, barriers are often interdependent of each other, where barriers from different categories co-occur or reinforce each other [26]. Understanding these interdependencies of barriers is central for explaining their occurrence and persistence, as well as determining how to overcome them [26]. Moser and Ekstrom [28] suggested that barriers can be overcome with leadership, strategic thinking, resourcefulness, creativity, collaboration, and effective communication between multi-level actors.

While there is a growing research interest on barriers to adaptation for various socio-ecological systems [23,25,28,32], research on identifying and overcoming barriers in the heritage preservation discipline is relatively limited [13]. In response, the NPS has been focusing considerable attention incorporating climate change in planning, prioritization and decision-making for natural and cultural heritage. The Secretarial Order No. 3289 [33] demonstrates the urgent need to plan and develop climate change adaptation strategies for cultural heritage; however, few efforts have made it to the implementation stage [19]. Therefore, there is a need to identify the specific barriers at all stages of adaptation process, which can bridge the gap between climate change science and climate adaptation planning and implementation for heritage preservation.

A rising discourse around barriers to cultural resource adaptation in the published literature is constructed broadly around four dimensions: institutional, technical, financial and social barriers. Institutional barriers to cultural research adaptation, including limited legislative instruments or the absence of policies and guidelines, can impede the design and implementation of adaptation strategies e.g., [10,15,34–38]. Similarly, political inertia and a lack of flexibility can hinder successful climate adaptation of cultural heritage e.g., [14]. Furthermore, limited awareness of climate change science and the lack of partnerships and collaborations between local, state and national levels can pose barriers to effective adaptation e.g., [39–41].

Technical barriers to heritage preservation under changing climate conditions can relate to inefficient or the lack of technical skills for making decision about adaptation, e.g., [34,35,41], as well as to limited procedures for gathering data or monitoring cultural resource conditions e.g., [41–46]. Further, research on the climate change impacts on cultural resources is limited [39,47]; when coupled with climate change uncertainty, this knowledge insufficiency may hinder adaptation or preservation, e.g., [24,41].

Social barriers to adaptation can arise from various factors, such as the perceptions, values and norms found within society or the decision-making sphere [23,32]. For example, Sherren et al. [48] found that cultural values, symbolism, and place attachment were considerable barriers to the

adaptation planning of a cultural landscape. Limited motivation and the willingness to act [45], as well as conflicting perceptions about the viability of adaptation or preservation strategies [41], have also emerged as major factors constraining climate adaptation processes.

Financial barriers in a heritage adaptation and preservation contexts are primarily related to the lack of funding, but also to limited tax incentives for sustainable maintenance [39], limited access to financial resources, and changing market dynamics [45]. Additionally, limited financial willingness to mobilize funding for research and new technologies have been identified as a substantial barrier e.g., [15,34]. Phillips [41] also notes that climate adaptation requires significant financial investments; however, the financial benefits of adapting cultural resources are often less clear, possibly due to conflicting planning time-scales [39].

It is worth noting that technical barriers often interact with financial and social adaptation barriers [12]. For instance, certain technologies and technical skills that may overcome institutional barriers (e.g., a tool that facilitates the prioritization of funding allocations) may not be widely accepted from a socio-cultural perspective (e.g., stakeholders' individual preferences and values). Despite the plausibility of interactions, research in heritage preservation has largely been singular, identifying either institutional, financial, technical, or social barriers that hinder climate change adaptation process. To enable more durable and efficient responses to the challenges that adaptation presents, there is a need to move beyond single-disciplinary assessments and identify inter-disciplinary barriers for climate adaptation of cultural heritage. Outside of the heritage preservation field, Eisenack et al. [26] highlight the importance of understanding how barriers are related to each other and how these may change over time. Similarly, Moser [49] recognized the need for more empirical studies to explore the growing importance of barriers to adaptation. Therefore, this paper seeks to advance our understanding of barriers—and the interdependencies of those barriers—to climate change adaptation for heritage preservation, as well as to identify possible solutions for overcoming these challenges.

2. Materials and Methods

To identify current barriers to climate adaptation of cultural resources and strategies for overcoming those barriers, we elicited the opinions of historic preservation and cultural resource management experts in the southeastern U.S. using online survey research methods [50]. We opted for a regional assessment, as climate change threats and impacts vary depending on geographic location and associated biophysical conditions within those locations [12]. Furthermore, a regional assessment was selected as it represents the second-level of the NPS' hierarchical order of policy and decision-making. The southeast region was selected due to ongoing cultural resource climate adaptation planning research being conducted in collaboration with the NPS at Cape Lookout National Seashore (North Carolina, USA). Data presented in this paper are part of a larger research project and only represent a subset of questions. The full questionnaire contained 4 sections with 41 questions; 2 sections with 10 questions are used for this paper.

2.1. Questionnaire

Specific questionnaire items included in this study are: (a) 6 questions about professional background and work experience of the expert (closed-ended), and (b) a series of 4 open-ended questions to assess expert opinion about important heritage preservation challenges presented by sea level rise and stronger or more frequent storms in coastal environments and identify strategies and information needs to overcome those challenges. Specifically, respondents were asked to list up to three of the greatest challenges related to heritage preservation (i) policy and (ii) practice, and up to three of the greatest (iii) strategies to overcome those challenges and (iv) information, training, and guidance needs to overcome those challenges or implement that strategies. The survey instrument was developed and administering using Qualtrics (Provo, UT, USA) survey software (v.2017).

2.2. Sampling

Purposive sampling [51] was used to recruit the experts actively working in the field of heritage preservation across southeast region of the U.S. In this study, an expert is defined as an individual known to NPS personnel with specialized knowledge or technical expertise in cultural resource management and/or historic preservation. A list of 85 experts was developed by the NPS Southeast Regional Office and Washington DC Office. We sought experts with various primary responsibilities and decision-making authority to obtain a variety of opinions and concerns. This list included experts from federal (i.e., NPS) and state governments (i.e., State Historic Preservation Offices), as well as non-profit organizations (e.g., National Trust for Historic Preservation, tribal organizations), academics, and architects and engineers from the private sector.

In February and March 2017, each expert was contacted via email announcing they would be receiving a telephone call in one of the following three days to receive information about the study's goals and the structure of the online questionnaire, as well as to confirm voluntary participation in the study. Accordingly, one week later each expert received the link to and instructions for completing the online questionnaire. Two reminder emails were sent to non-respondents during a one-month period. Once an expert had completed the questionnaire, that individual received no further reminders. Non-respondents and those who only partially completed the questionnaire were sent a final email request after an additional two-week period. This study was conducted in accordance with the Declaration of Helsinki, authorized by the U.S. Office of Management and Budget (OMB No. 1024-0278), and all protocols were approved by the Institutional Review Board for work with human subjects at NC State University (IRB Protocol No. 6339).

2.3. Data Analysis

We analyzed the participant background information (responses were downloaded from Qualtrics into a Microsoft Excel spreadsheet) using descriptive statistics. To analyze the qualitative data from open-ended questions, we utilized content analysis [52]. Specifically, data were downloaded as text into a Microsoft Excel spreadsheet and coded by one researcher; then the pattern of coding was corroborated and additional coding considerations suggested by a second researcher (peer debriefing; [53]). This process leads to further refinement of subthemes and relationships between subthemes. The coding process included first categorizing the main four themes of codes such as "policy challenge", "practice challenge", "strategies", and "needs" according to the questionnaire question (i.e., descriptive coding; [54]), and then further elaborating into subthemes derived from the data (i.e., open coding; [54]). Then, we condensed content coded as either "policy challenge" or "practice challenge" into one main theme titled "barriers". Similarly, we condensed content coded as "strategy" or "needs" into "needs". Then, we classified both the "barriers" and "needs" themes as relating to one of three categories: "institutional", "technical", or "financial". Additionally, using axial coding [54], we analyzed and developed conceptualization of relationships or interdependencies among the subthemes of barriers.

Once all open-ended responses were coded, we calculated frequencies of each subtheme to illustrate the range of experts' perceptions. In our Results section (Section 3), we report the number of references made by the participating experts for each subtheme with "n" to illustrate how frequently the barrier or need was encountered, experienced or identified. It is important to note that experts did not intuitively differentiate barriers or needs as institutional, technical, or financial; rather, the authors identified these categories within experts' responses and were guided by the existing literature on climate change adaptation [25,28,32]. We also provide some representative quotations in a table to provide support for our analysis [55]. It is worth pointing out that we did not intend to carry out a statistically significant assessment of identified barriers and needs; rather, the exploratory nature of the study is intended to provide some important insights about the types of barriers, their interdependencies, and needs for overcoming them as identified by experts and interpreted by researchers. Additionally, it is important to note that the frequency with which barriers were

mentioned reflect the saliency of each barrier and need to the experts who participated in this study and, as such, do not reflect relative importance. Future research that presents these barriers and needs in close-ended questions is needed to determine the importance or urgency of each as well as the strength of the relationships between interdependent barriers.

3. Results

In this section, we first provide a profile of study respondents (Section 3.1). Then, we present the main findings, which are organized by perceived perspectives on: (a) barriers to heritage preservation given climate change impacts; (b) interactions or interdependencies between identified barriers; and (c) needs to overcome barriers for adapting cultural resources to changing climatic conditions. We found that the barriers, as well as the barriers and needs, appear to be interdependent in many cases; these interdependencies are noted using parenthetical references throughout our presentation of the barrier findings (Section 3.2). A discussion of interdependencies between the barriers is presented in Section 3.3, and the needs are presented in Section 3.4.

3.1. Questionnaire Respondents

From our original sample of 85 experts sent the initial email request, 6 experts sent reply notifications that they did not feel qualified (lack of expertise or in-depth knowledge). After removing these 6 individuals, our valid sample was 79 experts. We received a total of 39 completed questionnaires, which resulted in a 49% response rate. We received notification from 5 experts with a reason for not participating in the study, which included time constraints ($n = 4$) and a disbelief in anthropocentric climate change ($n = 1$). The characteristics of experts' professional background and work experiences are displayed in Table 1.

Table 1. Characteristics regarding experts' type of organization, number of work experiences in heritage preservation, geographic region of work experiences in heritage preservation, and number of years of experience in current position and current organization ($n = 39$).

Type of Organization	Number of Work Experiences	Geographic Region of Work Experiences *	Years of Experience in Current Position	Years of Experience in Current Organization
Federal government: $n = 17, 44\%$	1 experience: $n = 15, 38\%$	South Atlantic U.S.: $n = 27$	1–4 years: $n = 15, 38\%$	15–20 or more years: $n = 17, 44\%$
State government: $n = 8, 20\%$	2 experiences: $n = 11, 28\%$	Gulf Coast U.S.: $n = 23$	15–20 or more years: $n = 10, 26\%$	10–14 years: $n = 12, 31\%$
Private contractor or consultant: $n = 6, 15\%$	3 experiences: $n = 8, 21\%$	Mid Atlantic U.S.: $n = 11$	10–14 years: $n = 9, 23\%$	10–14 years: $n = 6, 15\%$
Academic institution: $n = 4, 10\%$	4 experiences: $n = 3, 8\%$	North Atlantic U.S.: $n = 9$	5–9 years: $n = 5, 13\%$	1–4 years: $n = 4, 10\%$
Historic preservation organization: $n = 3, 8\%$	5 experiences or more: $n = 2, 5\%$	Great Lakes U.S. and Central U.S. (both): $n = 7$		
Local government organization: $n = 1, 3\%$		Rocky Mountain U.S.: $n = 6$		
		Pacific Northwest and California (both): $n = 5$		
		Caribbean U.S.: $n = 4$		
		International: $n = 3$		
		Pacific Islands U.S.: $n = 2$		
		Southwest U.S.: $n = 1$		

* Note that majority of experts had multiple regional employment experiences.

Nearly one-half of experts worked for federal government (44%), followed by state government (20%), private contractor or consultant (15%), academic institution (10%), historic preservation organization (8%) and local government organization (3%). Experts averaged 9 years of experience in their current position (range between 1 and 20 and more years), while their average experience working in the current work organization was 13 years (range 3–20 and more years). About one-third of experts (38%) had only one cultural resource management or historic preservation employment experience, while nearly another third (28%) had also previously held another heritage preservation position. About one in five experts (21%) had three heritage preservation positions, and a few experts had four positions (8%) or five (5%). Nearly two-thirds of experts conducted their work in South Atlantic region (25%), Gulf Coast region (21%), or the Mid-Atlantic region (10%), North Atlantic region (8%). Some respondents reported that the majority of their work experiences were in other regions: Great Lakes and Central US regions (both 6%), Rocky Mountain and California (both 5%), Pacific Northwest and Caribbean regions (both 4%), internationally (3%), Pacific Islands (2%) and Southwest region (1%).

3.2. Barriers to Heritage Preservation and Adaptation

Experts identified a large number of barriers (a total of 226 barriers were listed by study participants). We synthesized the diversity of barriers into **16 distinct barrier subthemes** and classified the 16 subthemes into 3 main categories of barriers, which organize our presentation of the subthemes: (a) institutional barriers, (b) technical barriers, and (c) financial barriers (Figure 1). Social barriers were not specifically mentioned.

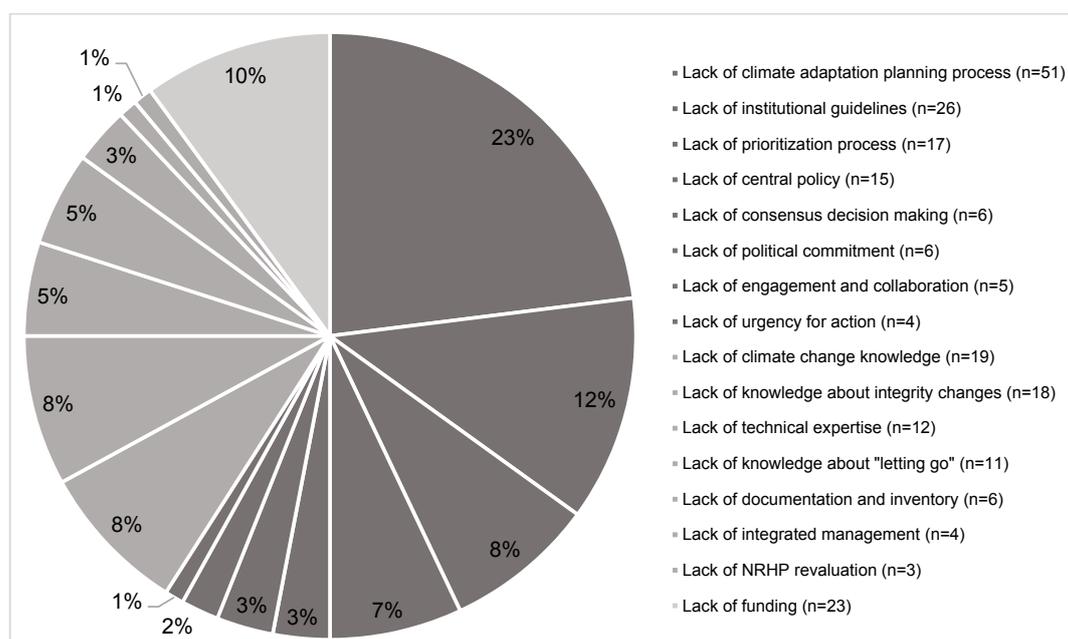


Figure 1. Percentage and number of mentions for institutional barriers (in darkest grey colors), technical barriers (in medium grey colors) and financial barrier (in light grey color) to current heritage preservation given climate change impacts (n = 226).

3.2.1. Institutional Barriers

Survey responses revealed that the most salient barrier is a **lack of effective planning processes and implementation strategies** for climate adaptation of cultural heritage (51 mentions). One expert specifically noted lack of leadership at higher levels of government as a barrier to adaptation planning and implementation. Climate adaptation planning and implementation appear to be a great challenge,

which requires considerable research (technical need) on reducing the vulnerability of cultural resources through protection and manipulation of the broader landscape, together with exploring feasible climate adaptation options (technical need) that would not affect the significance or integrity of cultural resources (technical need). Experts specifically expressed concern regarding the relocation and elevation of historic buildings as adaptation strategies that have been traditionally implemented, opining that these two actions can adversely affect a resource's significance; hence, they call for more research in this aspect (technical need) and to explore new ways of flexible management and preservation (institutional need).

A second salient barrier was the **lack of institutional guidelines and adequate procedures** on how to carry out climate adaptation of already vulnerable cultural resources to climate change (26 mentions). Experts expressed that there is an inescapable need for developing guidelines and strategies (institutional need) that help managers and decision-makers efficiently preserve cultural resources threatened by present and future climate change. Experts often stated that current guidelines for heritage preservation do not transparently guide what to do given climate change impacts and that current guidelines are not integrated with other federal or state agencies' guidelines, standards, or legislation documents. Some experts commented that barriers can result in lengthy decision procedures triggering inefficient decision-making for preservation and adaptation. Overcoming these barriers was noted as a critical (institutional) need for initiating climate adaptation planning, which was observed as a main barrier to current heritage preservation efforts.

Similarly, a **lack of central policy for guiding heritage preservation under climate change** (15 mentions) was identified as an institutional barrier to current efforts, which can also hinder proactive adaptation planning and implementation processes (institutional need). As previously mentioned, the NPS issued Policy Memorandum 14-02, which directs managers to prioritize the most significant and most vulnerable cultural resources. However, experts indicated that little is known regarding how this policy memorandum has influenced the management decisions to date (technical need). Relatedly, a **lack of prioritization process for climate adaptation of cultural resources** (17 mentions) was also frequently mentioned by experts. This barrier reflects the lack of methods or approaches to assess and prioritize funding allocations for implementing adaptation actions on specific cultural resources (technical need). In particular, a process for distinguishing the relative significance among cultural resources was noted as lacking, which is problematic given that some cultural landscapes have numerous cultural resources that have been listed on the NRHP. As such, experts expressed that a transparent method for differentiating between significant cultural resources is needed (technical need), which is necessary prior to developing a prioritization process for adaptation planning and decision-making (institutional need).

Impediments that arise from existing policy and associated regulations and laws were also noted to be resulting from the lack of coordination or collaboration between government agencies and stakeholders (institutional need) who act upon the same territory where cultural resources are located (e.g., wildlife management, urban planning, emergency management). A few experts specifically mentioned that a **lack of consensus decision-making** (6 mentions) among government agencies, stakeholders and communities, together with limited shared discourse between government and scientists, act as an institutional barrier to heritage preservation and climate adaptation. Relatedly, experts also noted that a **lack of engagement and collaboration** (5 mentions) between government agencies and various stakeholders (including the lack of sharing information about good practices and the lack of trusted relationships between communities and government agencies) impede effective practices for heritage preservation given climate change risks. Experts perceived that this group of barriers often do not promote the necessary cross-disciplinary collaborations and co-production of knowledge for effective heritage preservation and adaptation (institutional and technical needs). It was stressed that these barriers can create adverse outcomes for cultural resource management, including power imbalances and distribution of financial resources.

A **lack of political commitment** (6 mentions) caused by climate change skepticism and a lack of scientific/climate literacy—including the lack of political pressure on national and state government agencies to implement proactive adaptation actions—were mentioned as institutional barriers for developing climate change policy, climate adaptation planning, and the implementation of adaptation strategies. Interestingly, only one expert perceived that heritage preservation is not and may not be affected by the changing climate, believing the management can go through these changes simply using “business-as-usual” approach towards climate change risks. A few experts also mentioned the **lack of urgency for action** (4 mentions), which reflects a lack of knowledge about climate change impacts on cultural resources and feasible adaptation strategies (technical barriers) and the limited procedures for documenting and inventorying cultural resources (technical need). It was noted that these barriers should not be considered as an excuse for current and future inaction.

3.2.2. Technical Barriers

The **lack of climate change knowledge** (19 mentions), including a lack of information on climate change scenarios for various spatial scales (technical need) and a lack of comprehensive climate change risk and vulnerability assessments for diverse cultural heritage types (technical need), creates technical barriers to current management and preservation efforts. Interestingly, the experts did not identify the barrier of climate change uncertainty per se, but instead draw on specific contexts where the knowledge needs pose barriers to heritage preservation. Coupled with these knowledge barriers, experts often expressed the lack of research on methods and approaches for assessing the significance of cultural resources (technical need) and a lack of transparent methods for assessing diverse values that cultural heritage embodies (technical need), both of which are necessary for listing on the NRHP.

Experts also documented a concern about the **limited understanding of how adaptation can change the integrity of cultural resources** (18 mentions). Currently, historic integrity is determined based on an assessment of seven factors, which are the cultural resource’s location, design, setting, materials, workmanship, feeling and association; yet, there is no systematic assessment that quantifies these aspects of integrity and experts noted that the current methodology for assessing a cultural resource’s integrity needs to be revised and improved (technical need). Regardless of this short-coming, experts explained that it is necessary to understand how any of the seven aspects of integrity may change from climate-related impacts or the application of adaptation actions. In fact, the concern was raised that once integrity is lost, it might be lost forever.

Furthermore, experts perceived that there was a **lack of technical expertise** (12 mentions) for efficiently and effectively cope with climate change impacts within the heritage preservation field, including an unfamiliarity with existing adaptation practices and their technical feasibility. Technical know-how to adapt to climate change is primarily influenced by the lack of climate change knowledge, limited research on climate change impacts to cultural resources, and the lack of appropriate training in cultural resource adaptation (technical needs). Furthermore, while some information may exist, the lack of capacity to understand climate change data, together with a lack of training in climate adaptation planning tools and techniques, can impede informed decision-making for heritage preservation (technical needs).

Our findings show that **lack of knowledge about “letting go”** or the deliberate decision to allow for the loss of cultural resources (11 mentions) is another technical barrier to heritage preservation in the face of climate change. This barrier considers the fact that due to climate change uncertainty and economic and political constraints, not all cultural resources within a cultural landscape may be preserved or adapted for the enjoyment and benefits of future generations. For instance, a few experts described that nature will take its course no matter what managers do, that decision-makers need to start acknowledging that some elements of cultural heritage will not be fully maintained and can be lost, or that climate change already challenges long-term feasibility of heritage preservation.

In similar vein, the **lack of documentation and inventory of listed cultural resources** (6 mentions) was perceived as barrier that impedes successful management and preservation.

Experts noted that this issue not only applies to a climate change context but also to other threats such as vandalism, trafficking, ageing and urban or rural development. Experts pointed out that there are currently limited techniques for heritage surveying and lack of comprehensive documentation or digitalization of various cultural resources, especially for archaeological sites. Improved documentation and inventory methodologies (technical need) can enhance heritage preservation generally and with regard to adapting cultural resources to climate change impacts.

The **lack of NRHP reevaluation** (3 mentions) highlights the importance of developing improved criteria for nominating potentially eligible cultural resources to the NRHP, specifically focusing on cultural resources that are at risk from being lost due to changing climate conditions. Additionally, this technical barrier shows interdependencies with financial (lack of funding) and technological (lack of knowledge about assessing historical integrity) barriers. Together, these barriers indicate the pressing need for a better understanding of the specific relationship between climate change impacts, criteria for listing on the NRHP, and strategies for adapting to climate change hazards (technical needs).

The **lack of integrated cultural resource and natural resource management** (4 mentions) was considered by a few experts as a technical barrier to current heritage preservation efforts, particularly given climate change risks. Even though natural resources and cultural resources on the same landscape or within the same park unit are highly interdependent (and cultural landscapes encompass the natural resources and wildlife or domestic animals therein), they are usually managed as distinct resources. Therefore, these experts described that planning and decision-making is constrained by single-discipline research, which can hinder sustainable preservation and adaptation strategies, and technical skills are needed for holistic and integrated management approach (technical needs).

3.2.3. Financial Barriers

Perhaps not surprisingly, the experts perceived a **lack of funding** (23 mentions) to be a considerable factor constraining preservation practice and policy for heritage preservation, particularly related to planning and implementing climate adaptation strategies. Experts' responses related to this financial barrier also indicated concern for potential funding cuts by the new U.S. administration within the National Flood Insurance Program, including its funding for updating flood maps across U.S. and eliminating the Federal Historic Preservation Tax Incentives program that encourages private sector investment in the rehabilitation and reuse of historic buildings. In considering the interdependencies between barriers, we found that this barrier drives most of the institutional and technical barriers in this study.

3.3. Interdependencies of Identified Barriers

To better visualize the interrelationships between the barriers to heritage preservation given climate change threats, we developed a concept map that illustrates how the barriers are dynamically interdependent and are not mutually exclusive (Figure 2). The most frequently mentioned barriers by the experts (e.g., lack of climate adaptation planning and implementation, ineffective guidelines, lack of funding, and inadequate knowledge about cultural heritage and climate change) are shown to be clearly interdependent. For instance, the lack of effective adaptation planning is closely intertwined with the lack of knowledge about climate change processes and the lack of technical expertise, as well as the lack of funding and the lack of guidelines for climate adaptation planning. Similarly, the lack of climate adaptation prioritization process highlights the lack of central policy development, the lack of consensus-based decision-making, the lack of guidelines, and the lack of funding, as well as the lack of knowledge about historic integrity changes and the lack of knowledge about climate change. The lack of engagement and collaboration appears to be intertwined with the lack of coordinated and integrated climate change planning initiatives by other government agencies, and a lack of technical expertise. Another example is knowledge limitations (i.e., knowledge about climate change processes, integrity changes, and "letting-go"), which can be limiting factor for some other technical barriers, such as the lack of technical expertise or the lack of NRHP reevaluation. Importantly, almost all technical barriers

are interdependent with a lack of funding, such as insufficient financial support of federal and state funding for heritage preservation under changing climatic conditions. Funding barriers also drive most of the institutional barriers identified in this study.

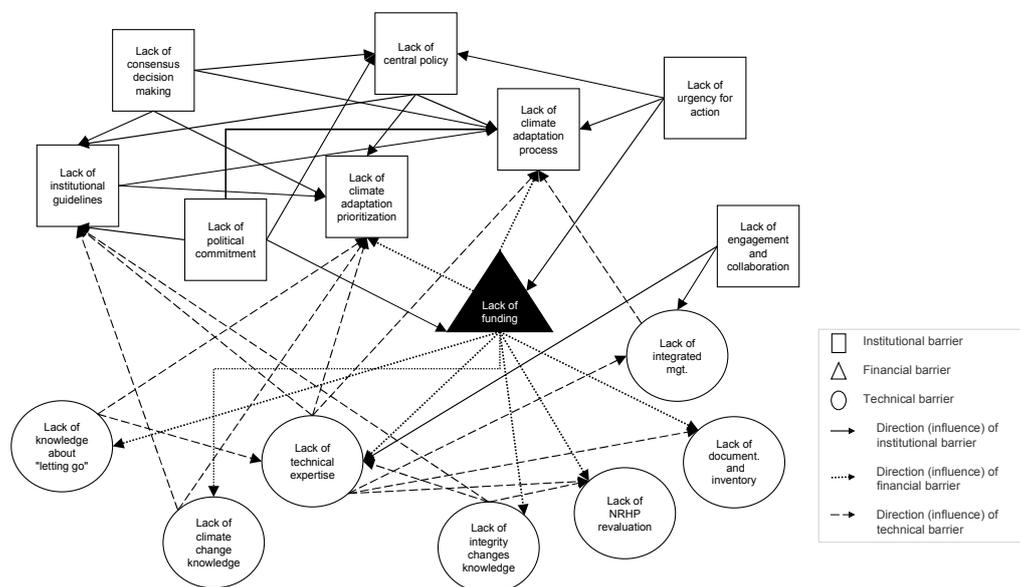


Figure 2. Conceptualization of barrier interdependencies for heritage preservation under changing climate conditions. Institutional barriers are in square boxes with solid arrows showing direction (influence) of interdependencies; the triangle shows a financial barrier together with the dotted arrows showing its influence on other barriers; circles are technical barriers with corresponding dashed arrows showing the direction of interdependencies with other barriers.

3.4. Needs for Overcoming Identified Barriers

Diverse needs were identified as critical to overcome barriers to heritage preservation given climate change. The 214 needs identified by the experts who responded to the study were synthesized into **8 main subthemes** (Figure 3). To demonstrate the links between barriers and needs, we display examples of verbatim responses provided by the participating experts in Table 2.

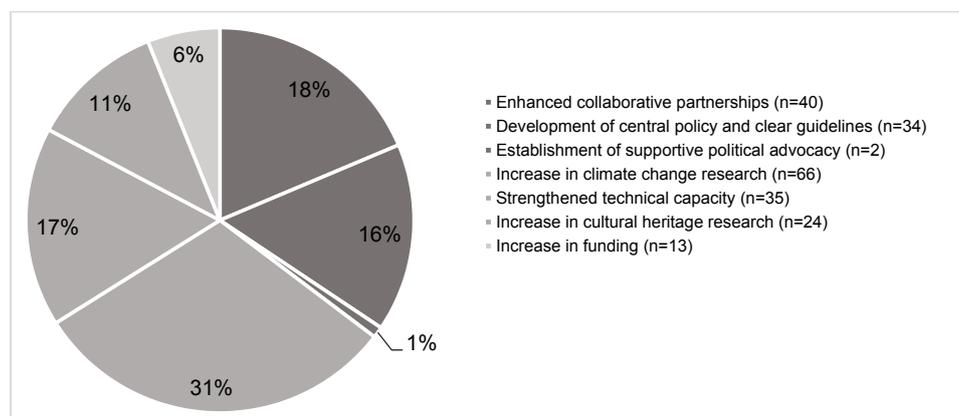


Figure 3. Percentage and number of mentions for institutional needs (in darkest grey colors), technical needs (in medium grey colors) and financial needs (in lightest grey color) to overcome barriers to current heritage preservation given climate change impacts (n = 214).

Table 2. Questionnaire data reflecting range of barriers that can limit cultural heritage management and historic preservation given climate change risks, together with suggested needs for overcoming these barriers.

Barrier	Questionnaire Quote of Barrier	Need for Overcoming Barrier
Lack of climate adaptation process	“Coastal areas more susceptible to deterioration that contain historic resources need better protections for how to prepare and react when sea levels rise, storms occur, etc.”	“Adaptation through public engagement and acknowledgment of need for change.”
Lack of guidelines	“Administrators need clarity as to what legal options are available (for current stewards to divest threatened resources they can no longer protect, to form partnerships with others to provide the protection, etc.).”	“Illustrated guidelines from NPS defining acceptable applications of the Standards.”
Lack of funding	“No budget to maintain required protections.”	“Provide funding to identify needs and preparation for climate change.”
Lack of knowledge on climate change and cultural heritage	“Yes, there are challenges in terms of the sea level rise and frequent storms. How serious are they in a short and long run? We need to have enough evaluation, information and data which show the impact of the climate change on the resources. Lack of seasonal inspection and evaluation of the impact of the climate and the rise of sea level on the resources is a challenge.”	“Modeling—sea level and/or climate change modeling should be mandated.”
Lack of knowledge on historic integrity changes	“Lack of knowledge, information and education. This includes the resource's values, knowing historic materials and the cultural heritage technique of construction, environment impact on the historic materials overall and in particular.”	“The CRM community needs to determine what, if any changes are necessary or applicable to properties threatened by sea level rise, etc. For example, can certain buildings be relocated when that would not otherwise be an acceptable treatment. Is it ok to raise floor levels in cases where the building sees water infiltration on a daily basis due to rising tides? Those of us who interpret and apply preservation standards are challenged by these questions and to approve work that would not otherwise be appropriate in the absence of specific guidance.”
Lack of climate adaptation prioritization	“In light of stagnant public funding and increasing threats to cultural resources, need info as to how to prioritize among the resources . . . ”	“A framework for evaluating vulnerability and significance to prioritize resources.”
Lack of central policy	“Need broader policy options for dealing with the threats. Think outside the box of current administrative rules and policies.”	“Providing policies, guidelines and procedures in this regard.”

Table 2. Cont.

Barrier	Questionnaire Quote of Barrier	Need for Overcoming Barrier
Lack of technical expertise	"Repeated and frequent events challenge agencies (governmental, non-profit) with limited staffing and financial resources to provide the technical assistance needed by property owners. So too there are limited craftsmen and trades people, and they are not able to do all of the work required and in the timeframe necessary."	"More climate change training on adaptation options and vulnerability assessments."
Lack of knowledge on "letting go"	"These climate changes are challenging us to really consider feasibility of long term preservation and forcing us to consider letting resources go to redirect limited funds or to preserve other resources."	"Increase inventory and monitoring of resources that cannot be saved and plan accordingly."
Lack of consensus decision making	"Lack of unified response among state and federal agencies."	"Early consultation with Tribal nations and Tribal Historic Preservation Offices."
Lack of documentation and inventory	"Having inadequate inventories of resources so the risk of loss is unknown."	"Undertake comprehensive resource inventories."
Lack of political commitment	"Lack of support from political leadership on climate change and sea level rise initiatives."	"Education of politicians and policy makers."
Lack of engagement and collaboration	"Deference to local knowledge and decision-making may result in losses that can be addressed by decision-making frameworks at a larger scale."	"Creation of multidisciplinary teams to explore adaptation strategies at case study sites."
Lack of sense of urgency	"Convincing people that time is of the essence."	
Lack of integrated management	"Managing cultural landscapes and biotic cultural resources."	"Approaching adaptation as a cultural and natural integrated effort."
Lack of NRHP reevaluation	"50 year [eligible criteria for listing in NRHP] has to be reevaluated—lots of potential, future resources are threatened and need to be reevaluated."	

3.4.1. Institutional Needs

Enhancing collaborative partnerships among diverse multi-level actors from government agencies to private sector and engaging with local communities, as well as sharing their lessons learned and best practices, was a dominant need identified by study respondents (40 mentions). Experts identified these institutional needs as crucial to advancing heritage preservation practices, particularly for but not only limited to climate adaptation planning and implementation. Additionally, responses indicate that this need for enhancing partnerships is linked to the idea of sustainable development, community integration and participation in the management of cultural heritage, and multi-level co-production of knowledge. As such, experts also commented that strengthening partnerships can

help to reshape traditional decision-making rules of federal and state governments that enable more flexible and effective management and preservation processes under changing climate conditions.

The development of explicit **central policy and clear guidelines** (34 mentions) was also frequently cited as an institutional need to reduce climate change vulnerabilities and safeguard cultural heritage for present and future generations. Additionally, experts noted prioritization processes are needed to determine which cultural resources are most in need of adaptation. It is important to note that, although the NPS Policy Memorandum 14-02 [30] indicates that the most vulnerable and the most significant resources should be prioritized, there is currently no process for making distinctions between the relative significance of cultural resources listed on the NRHP. Experts also explained that the allocation of financial resources for climate adaptation should also look at the strategies that most efficiently reduce climate change risks. Additionally, experts noted that policy and guidelines need to focus on maintaining cultural heritage by defining a new range of feasible operations and maintenance treatments that consider changing climate conditions.

Experts also mentioned that decision-making processes in the context of heritage preservation under changing climate conditions requires the establishment of more **supportive political advocacy** (2 mentions). Specifically, these individuals explained that there is a need for increased awareness of the anthropogenic nature of climate change and the removal of inefficient bureaucratic rules and procedures that hinder heritage preservation by slowing climate adaptation planning and decision-making.

3.4.2. Technical Needs

The main technical need that can enable multi-level actors to alleviate or overcome the barriers identified by experts was an **increase in climate change research** to improve knowledge of climate change impacts and the effectiveness of adaptation strategies (66 mentions). A systematic, complete and up-to-date assessment of regional climate models and associated climate change scenarios, together with data about impacts to cultural resources from sea level rise, storms and hurricanes and coastal flooding, are fundamental to support management and planning efforts. Similarly, experts highlighted that cultural heritage adaptation planning and decision-making would be enhanced by having information on feasible climate adaptation strategies for cultural resources (i.e., carefully considering compliance with preservation standards established by the National Historic Preservation Act), information on mechanisms of cultural resource deterioration, and information on innovative and creative solutions for shoreline and ecosystem protection and restoration.

Experts also noted the need for **cultural heritage related research** (20 mentions). Specifically, experts described the need for research to help them transparently assess the values of cultural resources, update and identify new techniques for cultural heritage documentation (and to consider thorough documentation as a climate adaptation strategies), and develop methods and approaches for measuring and analyzing the significance of cultural resources. Relatedly, a few experts explained that building bridges across the different research disciplines is needed to overcome the often single-disciplinary studies. More specifically, these respondents indicated that there is a need to integrate diverse research approaches and methods to achieve more efficient and effective heritage preservation given the multi-disciplinary challenge of climate change.

The experts also explained that it is important for government agencies, non-governmental organizations, and practitioners to **strengthen their technical capacity** for directing and overseeing climate change adaptation and disaster preparedness and recovery efforts (35 mentions). It was stressed that training was needed in a few specific realms: the use of proper materials and techniques; GIS mapping and modeling of coastal risks and vulnerability assessments; 3D imaging for documentation and inventorying (including deterioration); and emerging techniques for maintaining and repairing cultural resources. Moreover, experts opined that of critical need is to provide education and training to property owners, as well as to organize multi-disciplinary workshops and courses among various

multi-level experts to transfer technical knowledge and skills, as well as provide training necessary for securing funding for climate adaptation.

3.4.3. Financial Needs

Increased funding (13 mentions) for research and technical skills was noted as necessary to support the assessment of cultural resource vulnerabilities and improved scalable climate change modeling and scenarios, which in turn can inform decision-making for both cultural resource management and climate adaptation. Experts also mentioned that increased funding is needed to: support engagement and communication with the public, share best practices with diverse stakeholders, and foster collaboration with local, state and national governments and academia. Experts recognized that adequate funding can prevent or minimize deterioration and reduce a risk of heritage loss.

4. Discussion and Conclusions

The barriers to climate change adaptation for heritage preservation identified in this study generally align with those presented in the currently few scholarly publications on this topic, which were outlined in the introduction to this paper. To the best of our knowledge, this paper presents the first attempt to specifically document barriers to climate change adaptation for heritage preservation and identify strategies for overcoming those barriers. Our emic approach specifically sought to categorize the barriers and needs most salient to cultural resource and historic preservation experts. Although we contextualized our study with coastal climate change impacts to cultural resources in the southeastern U.S., we found that the heritage preservation barriers and strategies to overcome those barriers are likely transferable to other regions and, perhaps, national and international scales.

We found that climate adaptation efforts for heritage preservation are impeded by institutional, technical and financial barriers, and that these three types of barriers are often interdependent. Additionally, while there are only a few studies that discuss how barriers can be overcome, e.g., [26], we identified some institutional, technical and financial needs to overcome the barriers identified. Importantly, this study demonstrates that barriers to heritage preservation were often identified and discussed as both barriers and needs, revealing the interchangeable perspectives provided within expert opinion. As such, barriers are not insurmountable or absolute, but can just as easily be seen as future opportunities for improving cultural resource management and heritage preservation. For instance, the lack of a prioritization process for adapting cultural resources to climate change impacts was identified as meaningful limitation within current preservation planning efforts. Yet, increasing research and improving knowledge of the various intersections of climate change and cultural heritage was one of the most salient means of developing a climate adaptation prioritization process to reduce the vulnerability of cultural resources.

Principal among the challenges described by experts were institutional barriers related to climate adaptation planning processes, policy guidance, and management guidelines. Conversely, a lack of political commitment and the lack of a sense of urgency—both of which were related to concerns about climate change skepticism or limited climate literacy—were less salient barriers, suggesting that the development of climate adaptation policies and practices may not be limited by changing political ideologies [56]. As such, there seems to be a pressing need for developing processes and procedures that enable adapting cultural resources to climate change impacts in ways that best sustain or reinforce the significant values embedded in those resources. Such efforts are in their infancy, such as the Climate for Culture initiative in the EU [57] and the Cultural Resources Climate Change Strategy in the US [19], and will require ongoing research to evaluate their effectiveness.

Similar to previous studies focusing on cultural heritage threatened by environmental or climate change, e.g., [15,34–36,46], our study confirms that limited policies and guidelines for the preservation of diverse cultural heritages, coupled with poor multi-level governance that spans territorial boundaries, pose fundamental threats to heritage preservation and climate adaptation.

We found that overcoming such institutional barriers needs to involve building internal capacity, such as increasing research of climate change impacts to cultural resources, research on feasible adaptation strategies for diverse types of cultural resources, improving technical skills, enhancing partnerships among multi-level actors, and fostering political advocacy for climate adaptation among decision-makers. These findings are in accordance with Moser and Ekstrom's [28] prior research on barriers to climate adaptation of socio-ecologic systems. Additionally, Maus [10] argued that—due to the absence of international policies for safeguarding cultural heritage at risk from climate change—the inclusion of a human-rights-based approach could add an additional normative layer to the debate and, thus, enforce or increase the level of international obligation. As the experts who participated in this study did not specifically mention any social barriers or needs, research that specifically targets the viability of this strategy and other socio-cultural solutions are needed.

Some recent studies conducted in Australia, Canada, U.K., and the U.S. found that climate adaptation prioritization is needed to make transparent decisions between what cultural resources to protect and preserve (for both current and future generations) and what cultural resources to release or “let go” e.g., [9,58–60]. As such, prioritization decisions need to be informed by deliberation with multi-level actors about feasible strategies that integrate the significance of cultural resources with climate change vulnerabilities to ensure continued preservation of diverse heritage values and resources [61]. Such deliberative and proactive planning process can also prevent the misuse of power and interests of some actors that were involved in the past cultural heritage management decisions. In this sense, Head [62] suggests that decision-makers should avoid the limitations of some past cultural heritage management or preservation decisions and enhance their operation with new techniques and approaches. As Tansey [46] argues, multi-level actors need to develop awareness of and plan for climate change impacts before detrimental conditions become fully manifested, and that managers need to embed climate change adaptation and prioritization into their advocacy and outreach activities.

Relatedly, the experts participating in this study noted that additional research on climate adaptation strategies and the significance of cultural resources—and training to improve technical expertise—could support successful preservation activities given current and future climate change impacts. These findings corroborate the observations of other researchers who have noted that planning and implementing climate adaptation strategies can be impeded by ongoing knowledge and skill insufficiencies, particularly related to evaluating preservation strategies, monitoring of and interpreting changes to materials and the values embedded within cultural resources, and understanding the acceptance of permanent losses to cultural heritage e.g., [36,39,42,44–46]. Moreover, Phillips [41] documents that even though knowledge and skills of adaptation may exist among various government levels, at a local site level, actors may not be fully knowledgeable. To overcome such barriers, Cassar and Pender [39] suggest cross-disciplinary cooperation as a necessary pathway to share information and best practices. Again, this study substantiates these suggestions by documenting expert opinion about the ability to overcome technical barriers by enhancing collaborative partnerships among various multi-level actors, exchanging experiences and practices through organized trainings, workshops and conferences, as well as by fostering more supportive and collaborative cross-disciplinary (i.e., integration of natural and cultural resources) decision-making.

Yet, the need for knowledge and technical skills are closely intertwined with financial barriers. Financial barriers (e.g., lack of funding for continued stewardship of cultural heritage, lack of funding for advancing climate change research and cultural heritage documentation, lack of funding for opportunities to improve technical skills) were put forward as impediments to successful climate adaptation of cultural resources. Insufficient funding for maintenance—let alone funding for climate adaptation planning and implementation—can exacerbate the deterioration of cultural resources and result in permanent cultural heritage losses [35]. Tansey [46] explains that different cultural heritage types (e.g., archives, archeological sites, historical buildings) often must compete for financial

investments and that without early involvement in institutional adaptation efforts by an advocate or interest group, some aspects of cultural heritage are unlikely to be a financial priority.

These financial concerns are not isolated to the U.S. context, as research conducted in the U.K. demonstrates limited funding for cultural heritage, generally, and between cultural and natural resources, specifically. For example, Cassar and Pender [39] suggest that a more equitable balance is needed between funding for cultural heritage maintenance, tax incentives for sustainable maintenance, and funding for technical skills. Additionally, Flatman [15] suggests that, without holistic management of cultural heritage and natural resources in coastal and marine environments, there is a direct threat to the protection of cultural heritage, as cultural heritage in the marine zone is often considered the lowest possible priority, particularly in comparison to natural resource conservation agendas. Thus, it seems prudent to expand the heritage preservation and climate change adaptation dialogue to more holistic (and international) audiences, including those policy- and decision-makers charged with setting budget priorities at various governmental levels, the natural resources field, and diverse stakeholder arenas.

Including the traditional knowledge and skills of local communities in climate adaptation efforts can reinforce and strengthen heritage preservation e.g., [38,40,63], which should include engagement in research, planning and implementation efforts. As suggested by UNESCO [16], research can serve as a means for capacity building among diverse multi-actors and to raise awareness among the public who, in turn, may help build public and political support for climate adaptation of cultural heritage. It is possible then that increased climate literacy could create the political impetus needed for new funding mechanisms or bolstered budget allocations for heritage preservation and climate adaptation research, planning and training.

Lafrenz Samuels [2] argued that cultural heritage can foster social understandings of phenomena that span generations like climate change. As such, understanding barriers is not only the key for scientific progress, but it can be a vital step to support politicians and decision-makers prepare for and manage barriers to climate change impacts [25]. The novelty of this study lies in our emic approach to documenting the barriers and needs salient to heritage preservation experts, as well as our analytical process for identifying interdependencies among institutional, technical and financial barriers. We hope that this effort will not only result in needed research and political support but also foster capacity-building efforts with cultural resource managers to plan for and respond to current and future climate change impacts. Additionally, we hope that this paper will encourage other scholars to contribute to this vital research, expanding our approach to other cultural resources, regions, and climate change impacts. Ultimately, securing the future of cultural heritage requires institutional, technical and financial solutions for preservation under changing climate conditions.

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References

1. Phillips, H. The capacity to adapt to climate change at heritage sites—The development of a conceptual framework. *Environ. Sci. Policy* **2015**, *47*, 118–125. [[CrossRef](#)]
2. Lafrenz Samuels, K. The cadence of climate: Heritage proxies and social change. *J. Soc. Archaeol.* **2016**, *16*, 142–163. [[CrossRef](#)]

3. NPS. National Register Bulletin: How to Apply the National Register Criteria for Evaluation. Available online: <https://www.nps.gov/nr/publications/bulletins/pdfs/nrb15.pdf> (accessed on 4 June 2017).
4. De la Torre, M.; MacLean, M.G.H.; Mason, R.; Myers, D. *Heritage Values in Site Management: Four Case Studies*; Getty Conservation Institute: Los Angeles, CA, USA, 2005.
5. Graham, B. Heritage as knowledge: Capital or culture? *Urban Stud.* **2002**, *39*, 1003–1017. [[CrossRef](#)]
6. NPS. National Park Visitor Spending Effects 2016: Economic Contributions to Local Communities, States, and the Nation. Available online: https://www.nps.gov/nature/customcf/NPS_Data_Visualization/docs/2016_VSE.pdf (accessed on 4 June 2017).
7. Marzeion, B.; Levermann, A. Loss of cultural world heritage and currently inhabited places to sea-level rise. *Environ. Res. Lett.* **2014**, *9*, 1–7. [[CrossRef](#)]
8. Sabbioni, C.; Brimblecombe, P.; Cassar, M. *The Atlas of Climate Change Impact on European Cultural Heritage: Scientific Analysis and Management Strategies*; Anthem Press: London, UK; New York, NY, USA, 2010.
9. Fatorić, S.; Seekamp, E. Evaluating a decision analytic approach to climate change adaptation of cultural resources along the Atlantic coast of the United States. *Land Use Policy* **2017**, *68*, 254–263. [[CrossRef](#)]
10. Maus, S. Hand in hand against climate change cultural human rights and the protection of cultural heritage. *Camb. Rev. Int. Aff.* **2014**, *27*, 699–716. [[CrossRef](#)]
11. Rockman, M. An NPS framework for addressing climate change with cultural resources. *George Wright Forum* **2015**, *32*, 37–50.
12. IPCC. *IPCC Fifth Assessment Report: Climate Change 2014, Working Group II: Impacts, Adaptation and Vulnerability*; Cambridge University Press: Cambridge, UK; New York, NY, USA, 2014.
13. Fatorić, S.; Seekamp, E. Are cultural heritage and resources threatened by climate change? A systematic literature review. *Clim. Chang.* **2017**, *142*, 227–254. [[CrossRef](#)]
14. Hall, M.C.; Baird, T.; James, M.; Ram, Y. Climate change and cultural heritage: Conservation and heritage tourism in the Anthropocene. *J. Herit. Tour.* **2016**, *11*, 10–24. [[CrossRef](#)]
15. Flatman, J. A climate of fear: Recent British policy and management of coastal heritage. *Pub. Archaeol.* **2009**, *8*, 3–19. [[CrossRef](#)]
16. UNESCO. Policy Document on the Impacts of Climate Change on World Heritage Properties. Available online: <http://whc.unesco.org/document/10045> (accessed on 4 June 2017).
17. Berrang-Ford, L.; Ford, J.D.; Paterson, J. Are we adapting to climate change. *Glob. Environ. Chang.* **2011**, *21*, 25–33. [[CrossRef](#)]
18. Caffrey, M.; Beavers, R. Protecting cultural resource sin coastal US national parks from climate change. *George Wright Forum* **2008**, *25*, 86–97.
19. Rockman, M.; Morgan, M.; Ziaja, S.; Hambrecht, G.; Meadow, A. *Cultural Resources Climate Change Strategy*; NPS: Washington, DC, USA, 2016.
20. Heathcote, J.; Fluck, H.; Wiggins, M. Predicting and adapting to climate change: Challenges for the historic environment. *Hist. Environ. Policy Pract.* **2017**. [[CrossRef](#)]
21. Amundsen, H.; Berglund, F.; Westskogh, H. Overcoming barriers to climate change adaptation—a question of multilevel governance? *Environ. Plan. C* **2010**, *28*, 276–289. [[CrossRef](#)]
22. Bierbaum, R.; Smith, J.B.; Lee, A.; Blair, M.; Carter, L.; Chapin, F.S., III; Fleming, P.; Ruffo, S.; Stults, M.; McNeeley, S.; et al. A comprehensive review of climate adaptation in the United States: More than before, but less than needed. *Mitig. Adapt. Strateg. Glob. Chang.* **2013**, *18*, 361–406. [[CrossRef](#)]
23. Hulme, M.; Adger, W.N.; Dessai, S.; Goulden, M.; Lorenzoni, I.; Nelson, D.R.; Naess, L.O.; Wolf, J.; Wreford, A. *Limits and Barriers to Adaptation: Four Propositions*; Tyndall Briefing Note 20; Tyndall Centre for Climate Change Research, University of East Anglia: Norwich, UK, 2007.
24. O'Brien, G.; O'Keefe, P.; Jayawickrama, J.; Jigyasu, R. Developing a model for building resilience to climate risks for cultural heritage. *J. Cult. Herit. Manag. Sustain. Dev.* **2015**, *5*, 99–114. [[CrossRef](#)]
25. Biesbroek, G.R.; Klostermann, J.E.M.; Termeer, C.J.A.M.; Kabat, P. On the nature of barriers to climate change adaptation. *Reg. Environ. Chang.* **2013**, *13*, 1119–1129. [[CrossRef](#)]
26. Eisenack, K.; Moser, S.C.; Hoffmann, E.; Klein, R.J.T.; Oberlack, C.; Pechan, A.; Rotter, M.; Termeer, C.J.A.M. Explaining and overcoming barriers to climate change adaptation. *Nat. Clim. Chang.* **2014**, *4*, 867–872. [[CrossRef](#)]

27. Archie, K.M.; Dilling, L.; Milford, J.B.; Pampel, F.C. Unpacking the “information barrier”: Comparing perspectives on information as a barrier to climate change adaptation in the interior mountain west. *J. Environ. Manag.* **2014**, *133*, 397–410. [[CrossRef](#)] [[PubMed](#)]
28. Moser, S.C.; Ekstrom, J.A. A framework for diagnosing barriers to climate change adaptation. *Proc. Natl. Acad. Sci. USA* **2010**, *107*, 22026–22031. [[CrossRef](#)] [[PubMed](#)]
29. Morse, J.M. *Critical Issues in Qualitative Research*; Sage: Thousand Oaks, CA, USA, 1994.
30. U.S. Department of Interior, National Park Service. Policy Memorandum 14-02. Available online: <https://www.nps.gov/policy/PolMemos/PM-14-02.htm> (accessed on 4 June 2017).
31. Matasci, C.; Kruse, S.; Barawid, N.; Thalmann, P. Exploring barriers to climate change adaptation in the Swiss tourism sector. *Mitig. Adapt. Strateg. Glob. Chang.* **2014**, *19*, 1239–1254. [[CrossRef](#)]
32. Adger, W.N.; Dessai, S.; Goulden, M.; Hulme, M.; Lorenzoni, I.; Nelson, D.R.; Naess, L.O.; Wolf, J.; Wreford, A. Are there social limits to adaptation to climate change? *Clim. Chang.* **2009**, *93*, 335–354. [[CrossRef](#)]
33. U.S. Department of Interior. Secretarial Order No. 3289. Available online: <https://www.doi.gov/sites/doi.gov/files/migrated/whatwedo/climate/cop15/upload/SecOrder3289.pdf> (accessed on 4 June 2017).
34. Breen, C. Advocacy, international development and world heritage sites in Sub-Saharan Africa. *World Archaeol.* **2007**, *39*, 355–370. [[CrossRef](#)]
35. Claesson, S. An ecosystem-based framework for governance and management of maritime cultural heritage in the USA. *Mar. Policy* **2009**, *33*, 698–706. [[CrossRef](#)]
36. El Mankibi, M.; Cantin, R.; Zoubir, A. Contribution to the thermal renovation of old buildings: Numerical and experimental approach for characterizing a double window. *Energy Procedia* **2015**, *78*, 2470–2475. [[CrossRef](#)]
37. Mitchell, N.J.; Barrett, B. Heritage values and agricultural landscapes towards a new synthesis. *Landsc. Res.* **2015**, *40*, 701–716. [[CrossRef](#)]
38. Sarma, R. Effects of globalization on the traditional cane and bamboo household objects: A case study on the Nyishi group of arunachal Pradesh. *Craft Res.* **2015**, *6*, 83–98. [[CrossRef](#)]
39. Cassar, M.; Pender, T. The impact of climate change on cultural heritage: Evidence and response. In *Proceedings of the ICOM 14th Triennial Meeting, The Hague, The Netherlands, 12–16 September 2005*; Verger, I., Ed.; Maney Publishing: London, UK, 2005; pp. 610–616.
40. Leon, J.X.; Hardcastle, J.; James, R.; Albert, S.; Kereseke, J.; Woodroffe, C.D. Supporting local and traditional knowledge with science for adaptation to climate change: Lessons learned from participatory three-dimensional modeling in BoeBoe, Solomon Islands. *Coast. Manag.* **2015**, *43*, 424–438. [[CrossRef](#)]
41. Phillips, H. Adaptation to climate change at UK World Heritage sites: Progress and challenges. *Hist. Environ. Policy Pract.* **2014**, *5*, 288–299. [[CrossRef](#)]
42. Daly, C. The design of a legacy indicator tool for measuring climate change related impacts on built heritage. *Herit. Sci.* **2016**, *4*, 1–12. [[CrossRef](#)]
43. Gomez-Heras, M.; McCabe, S. Weathering of stone-built heritage: A lens through which to read the Anthropocene. *Anthropocene* **2015**, *11*, 1–13. [[CrossRef](#)]
44. Haugen, A.; Mattsson, J. Preparations for climate change’s influences on cultural heritage. *Int. J. Clim. Chang. Strateg. Manag.* **2011**, *3*, 386–401. [[CrossRef](#)]
45. Pieroni, A. The changing ethnoecological cobweb of white truffle (*Tuber magnatum* Pico) gatherers in South Piedmont, NW Italy. *J. Ethnobiol. Ethnomed.* **2016**, *12*, 1–12. [[CrossRef](#)] [[PubMed](#)]
46. Tansey, E. Archival adaptation to climate change. *Sustain. Sci. Pract. Policy* **2015**, *11*, 45–56. [[CrossRef](#)]
47. Rodríguez Algeciras, J.A.; Gómez Consuegra, L.; Matzarakis, A. Spatial-temporal study on the effects of urban street configurations on human thermal comfort in the world heritage city of Camagüey–Cuba. *Build. Environ.* **2016**, *101*, 85–101. [[CrossRef](#)]
48. Sherren, K.; Loik, L.; Debner, J.A. Climate adaptation in ‘new world’ cultural landscapes: The case of Bay of Fundy agricultural dykelands (Nova Scotia, Canada). *Land Use Policy* **2016**, *51*, 267–280. [[CrossRef](#)]
49. Moser, S.C. Now more than ever: The need for more societally relevant research on vulnerability and adaptation to climate change. *Appl. Geogr.* **2010**, *30*, 464–474. [[CrossRef](#)]
50. Dillman, D.A.; Smyth, J.D.; Christian, L.M. *Internet, Mail, and Mixed-Mode Surveys: The Tailored Design Method*, 3rd ed.; John Wiley and Sons: Hoboken, NJ, USA, 2009.
51. Tongco, D.C. Purposive sampling as a tool for informant selection. *Ethnobot. Res. Appl.* **2007**, *5*, 147–158. [[CrossRef](#)]
52. Weber, R.P. *Basic Content Analysis*; Sage Publications: Newbury Park, NJ, USA, 1990.

53. Spillett, M.A. Peer debriefing: Who, what, when, why, how. *Acad. Exch. Q.* **2003**, *7*, 36–41.
54. Saldaña, J. *The Coding Manual for Qualitative Researchers*, 3rd ed.; Sage: Thousand Oaks, CA, USA, 2016.
55. Pratt, M.G. Fitting oval pegs into round holes: Tensions in evaluating and publishing qualitative research in top-tier North American journals. *Organ. Res. Methods* **2008**, *11*, 481–509. [[CrossRef](#)]
56. Hulme, M. *Why We Disagree about Climate Change: Understanding Controversy, Inaction and Opportunity*; Cambridge University Press: New York, NY, USA, 2009.
57. Fraunhofer. Climate for Culture. Available online: <https://www.climateforculture.eu/> (accessed on 15 November 2017).
58. Carmichael, B.; Wilson, G.; Namarnyilk, I.; Nadji, S.; Brockwell, S.; Webb, B.; Hunter, F.; Bird, D. Local and Indigenous management of climate change risks to archaeological sites. *Mitig. Adapt. Strateg. Glob. Chang.* **2017**. [[CrossRef](#)]
59. Dawson, T. Erosion and coastal archaeology: Evaluating the threat and prioritising action. In *Ancient Maritime Communities and the Relationship between People and Environment along the European Atlantic Coasts, Proceedings of the HOMER 2011 Conference, Vannes, France, 28 September–1 October 2011*; Daire, M.-Y., Dupont, C., Baudry, A., Billard, C., Large, J.-M., Lespez, L., Normand, E., Scarre, C., Eds.; BAR International Series 2570; Archeopress: Oxford, UK, 2013; pp. 77–83.
60. Robinson, M.H.; Alexander, C.R.; Jackson, C.W.; McCabe, C.P.; Crass, D. Threatened archaeological, historic, and cultural resources of the Georgia Coast: Identification, prioritization and management using GIS technology. *Geoarchaeology* **2010**, *25*, 312–326. [[CrossRef](#)]
61. Fatorić, S.; Seekamp, E. A measurement framework to increase transparency in historic preservation decision-making under changing climate conditions. *J. Cult. Herit.* **2017**. [[CrossRef](#)]
62. Head, L. Cultural ecology: Adaptation—Retrofitting a concept? *Prog. Hum. Geogr.* **2010**, *34*, 234–242. [[CrossRef](#)]
63. Vojinovic, Z.; Hammond, M.; Golub, D.; Hirunsalee, S.; Weesakul, S.; Meesuk, V.; Medina, N.; Sanchez, A.; Kumara, S.; Abbott, M. Holistic approach to flood risk assessment in areas with cultural heritage: A practical application in Ayutthaya, Thailand. *Nat. Hazards* **2016**, *81*, 589–616. [[CrossRef](#)]



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