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Review

Climate Impacts on Tangible Coastal Cultural Heritage in the United States: Towards Sustainable and Adaptive Coastal Heritage Management

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Abstract: Climate change is predicted to have severe impacts on coastal communities, including sea level rise, flooding, and coastal erosion, and is expected to reshape many coastlines. One further, and often overlooked, consequence of the climate crisis is the threat posed to cultural heritage sites in the coastal zone. The threat to coastal cultural heritage (CCH) will inevitably impact both tangible (physical and material) and intangible (socio-cultural) components of cultural, historical, and archaeological character along frontline coastal communities. This poses substantial sustainability challenges for stakeholders and decision-makers for the management of cultural heritage assets and for management practices to respond to increasing threats from climate change. This paper uses five illustrative examples based on maximum variation principles to evaluate different strategies (or 'steering' processes) for managing coastal heritage resources in the context of climate change. These include the traditional 'preservationist' perspective and trajectories based on discontinuity or transformation. We examine these issues with reference to five post-European heritage assets located along the East Coast of the USA. While a consideration of steering processes is important, we argue that it is necessary to also embrace the policies and strategies for adapting to and mitigating the impacts of climate change through which processes of managing CCH unfold. Adopting such a perspective can lead to more nuanced approaches for understanding how CCH can respond to the challenges of a changing climate.

Keywords: adaptive coastal heritage management; coastal cultural heritage; sustainable coastal heritage management; climate change; adaptation; coastal management; United States

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1. Introduction

For several millennia, coastal zones have been important in regard to the evolution of human societies. Coastal settlements have long been places that are open to the wider world. They became established places for trade, communication, and exchange with other peoples and societies. As such, distinctive forms of settlement developed on the coast, characterised by a distinctive architecture that was established on international trade and exchange [1]. At a later stage, coasts became popular destinations for leisure and tourism. This brought new people (and new activities) to the coast. Existing settlements expanded and were modified by the influence of tourism, while entirely new settlements emerged which owed their existence to tourism [2]. Coastal areas retain their significance and popularity in the 21st century. Around 40% of people globally live next to the sea [3,4], and millions more visit coastal areas for holidays.

Since the 19th century, the distinctive form, appearance and architecture of coastal towns has increasingly been recognised and valued as heritage. This heritage embraces the legacy of sea-borne trade and exchange, but also increasingly includes the unique townscapes created by leisure and tourism [5,6]. An increasing number of coastal buildings

enjoy statutory recognition and, sometimes, protection. Furthermore, the heritage of seaside towns are increasingly becoming attractions in their own rights, drawing visitors in search of an encounter with the coastal past [7,8].

However, due to the fact of the coast's location in the littoral zone, this is a heritage which is increasingly impacted by, and vulnerable to, global environmental change. In particular, the heritage of the coast faces increasing threats from rising sea levels [9]. Yet, this is an issue which, to date, has received limited research attention. While the impacts of climate change on built environments and social fabrics is receiving increased academic scrutiny, understanding of the consequences of the climate crisis for heritage remains in its infancy [10–13]. Yet, Howey [14] argues that identifying cultural heritage sites that are vulnerable to climate change impacts, such as sea level rise, is an urgent need. Furthermore, the ways in which the climate crisis will impact upon (and potentially reshape) the unique heritage of coastal settlements has been largely neglected.

It is this issue which we address in this article. In particular, with reference to the eastern coastline of the USA, we examine the ways in which the post-European-settlement-built tangible cultural heritage of the coast is impacted and threatened by climate impacts, e.g., rising sea levels. While there are many risks to tangible and intangible CCH, we specifically focus on the threat of climate change to tangible CCH. We examine the various ways in which heritage managers can respond to the threats and challenges of sea level rise. Central to our argument is that a focus on the 'preservation' of coastal heritage sites (with its emphasis on preventing or limiting change) will be problematic in the future. Instead, there is a need for a more flexible approach to management that accepts change (or even loss) in the face of rising sea levels. Crucially, this perspective entails an acceptance that not all forms of coastal cultural heritage (CCH) can be saved in the context of climate change. Therefore, it is important to adopt an approach to the management of coastal heritage sites which is grounded in adaptation (an approach to conservation which is about acceptance and management of change).

The aim of this paper is to evaluate approaches to the management of post-European-built tangible CCH in the context of climate change and rising sea levels. We begin by establishing the context of global environmental change and the ways in which this is likely to impact coastal settlements. We then examine coastal heritage in more detail and delineate and define CCH, identifying the current risks and threats that it faces. We go on to consider a framework recently proposed by Flannery et al. [15] for examining both the nature of CCH and the various strategies (continuity, discontinuity, and transformation) through which it can be managed. In the following section we use this framework to evaluate the management of five examples of tangible CCH located in the eastern U.S. We argue that, in order to adopt a more sustainable and resilient approach to the future of CCH, there is a need to embrace a range of management strategies that move beyond the traditional preservationist paradigm, but also that it is necessary to incorporate a fuller consideration of the socio-political approaches to climate change into understanding the future of CCH.

2. Literature Review

2.1. Contextualising the Threat of Climate Impacts on Coastal Cultural Heritage

The awareness of the possible risks connected with climate change and its impacts on environment and society is steadily increasing. In recent years, particularly in Europe, the cultural heritage sector has become conscious of the potential problems related to climate change impacts on the materials which constitute our "tangible culture". Meanwhile, state agencies in the U.S. have become cognisant of the challenges the climate crisis presents to coastal areas and important historical sites [16]. The Intergovernmental Panel on Climate Change first mentioned the "cultural heritage issue" in its Fifth Assessment Report in 2014. Specifically, Section 3.4.3. of the IPCC Working Group 3 of the Working Group 3, which addresses the impacts of climate change, emphasised the necessity of promoting people's wellbeing, including the loss of cultural heritage sites, as a metric of quality of life [17]. The impacts of climate change on cultural heritage have become a subject of

concern at local, national, and international levels. The consequences of climate change can exacerbate the exposure of CCH to various stressors, including sea level rise, flooding, erosion, and increasing temperatures [13,17,18]. The frequency and intensity of climatic hazards such as floods and hurricanes pose serious threats to both tangible and intangible cultural heritage [13] and their cultural and natural values [19,20].

The rise in temperature, coupled with alterations in precipitation, relative humidity, and wind patterns, can have adverse effects on the materials that constitute cultural heritage assets. This is because a change in average climatic conditions, as well as changes in the frequency and intensity of severe weather events, can affect the biological, chemical, and physical mechanisms, leading to degradation of coastal and underwater assets [18]. Examples of this include freeze–thaw cycles in Northern Europe, extreme heat and droughts in the Mediterranean region, and heavy precipitation events in the Atlantic region, as well as storm surges and flooding from hurricanes in North America [17,21–25]. Additionally, the overall impact of sea level rise and coastal geomorphological changes further exacerbate the risks faced by cultural heritage sites [17,26].

Over the past two decades, the 2 °C number has emerged as a critical threshold for global heating, with the aim of minimising global heating to 1.5 °C [27,28]. Yet, climate change does not heat the world evenly. In the United States, 1 in 10 Americans—or 34 million people—are living in rapidly heating regions, including coastal areas of New York City and Los Angeles. Seventy-one counties have already hit the 2 °C mark. Alaska is the fastest warming state in the country, but Rhode Island is the first state in the Lower 48 whose average temperature has eclipsed the 2 °C mark [29]. Other parts of the Northeast, including New Jersey, Connecticut, and Maine, trail close behind [29]. As the outputs from global climate models project that climatic changes will intensify over the current century, the magnitude of the projected change will become dependent upon the selected path of greenhouse gas emissions and the development model selected [30]. Consequently, strategies need to be designed and implemented to mitigate and adapt to the negative consequences of climate change on sites of historical value.

2.2. The Importance of Coastal Cultural Heritage

At this point, it is necessary to define 'coastal cultural heritage' (CCH). Khakzad et al. [31] identified CCH as a resource that encompasses the cultural and social connections, both past and present, of people with the land and the sea. This includes Indigenous culture, which should be recognised as such. This section, along with the examples we have included within this article, focusses on exclusively European 'imported' cultural items. Recent studies [15,31,32] recognise that CCH can include tangible and intangible heritage associated with human activities from the past, present, and potential futures within coastal and marine areas on land, sea (including underwater heritage), and the in-between space of the coastal margin between the land and sea. Tangible CCH can include unique coastal structures such as lighthouses, pleasure piers, or ports, whereas intangible CCH might include the practices of fishing villages (for example, specific skills and crafts such as boat building or the repair of fishing nets); the place identities of seaside resorts; or the practices of tourists that are associated with the seaside holiday [8]. In this article, we draw specifically on post-European-settlement tangible CCH, including Miami Beach's Art Deco buildings, New York City Harbor, and Hudson River Park. We focus our examples of tangible CCH by drawing on these examples of post-European-built architecture. However, we recognise that other types of CCH exist, e.g., Indigenous tangible CCH, and require further exploration. Ounanian et al. [32] (p. 2) state that CCH is constrained by the "conditions of the sea and the shore, which affect the preservation, protection, utilisation, and management" of these assets.

The CCH that exists in the eastern United States is varied and diverse and is characterised by rich cultural significance. As our understanding of the bond that exists between people and places intensifies, it becomes evident that the meanings invested in cultural heritage sites resonate on multiple levels that cannot be conceptualised solely in terms of

economic value [33]. Instead, it is important to recognise that cultural heritage is valued in a range of other ways by local communities: it may be important in grounding senses of local identity; it may underpin place attachment, defined as the "bonding that occurs between individuals and their meaningful environments" [34] (p. 1); and it may define relationships with the past. However, when socially constructed environments and landscapes are subjected to change from outside forces, the meanings and cultural values ascribed to those places by their communities are also under threat [35]. Climate change can pose a physical threat to tangible cultural heritage and landscapes but can also jeopardise the intangible values and meanings attached to these places by people for whom such heritage is important [36–39]. Indeed, the loss of CCH can evoke feelings of loss and trauma among local populations [9].

Ounanian et al. [32] identify four major risks and threats to tangible and intangible CCH. The first issue is the threat of climate change, including physical erosion of coastal areas due to storm surges; this in turn highlights the importance of proactive approaches to adaptation. The second issue is an over-reliance on the resilience of coastal areas (and the assumption that coastal areas can 'bounce back' to pre-crisis conditions). They argue that this approach favours the continuance of the status quo in a way which may prove to be unsustainable in the long term. A third issue is that much CCH may be underwater or otherwise hidden, and therefore specialist skills, training, or activities are necessary to make such cultural heritage understandable and accessible to a wider audience. Furthermore, some forms of CCH (such as shipwrecks) are increasingly vulnerable to leisure visitors or those seeking to plunder such resources. Finally, CCH is found in areas which are socially, economically, and politically peripheral. This means that such heritage is geographically and 'imaginatively' marginal. While each risk and threat to tangible and intangible CCH requires further study, this article specifically explores the threat of climate change on tangible CCH.

One significant form of CCH that is threatened by climate change is lighthouses. The U.S. Lighthouse Service was established in 1789, and, although lighthouses existed prior to this date, they were erected near important trade ports, cementing their role in navigation and local economic growth [40]. While the first permanent structure designed as a lighthouse in the U.S. has never been determined, Boston Light Station on Little Brewster Island in Boston Harbor is considered the earliest, displaying its first light in September 1716 [40]. Lighthouses are ubiquitous CCH assets worldwide, yet many now lie abandoned given the introduction of digitalisation and new navigational technologies [41,42]. However, Blake and Smith [43] argue that some Americans see lighthouses as the equivalent to European castles in that they provide a focal point for cultural memory. Furthermore, Blake [15,44] contends that lighthouses are anchors of local place identity and, irrespective of their geographic context, they conjure "deep meanings tied to nostalgia, permanence, faith, transcendence, and the value of personal connection to place in an increasingly globalised world". Such emphasis on visibility within the narratives of place identity and attachment to lighthouses are interwoven into the romanticisation of the broader narrative of maritime culture and history [40,44].

2.3. Climate Impacts on Coastal Cultural Heritage in the US: Threat Assessment and Regulatory Context

Poulter et al. [45] assert that coastal areas are facing the most imminent and some of the most devastating effects of climate change resulting from impending sea level rise, high tide flooding, and increased storm intensity and frequency. The impact on some international famous sites has already been documented. For example, landmarks such as the Statue of Liberty are known to be at risk from storm surges arising from more intense Atlantic hurricanes. The storm surge from Hurricane Sandy in 2012 submerged 75% of Liberty Island and destroyed the docks, sections of walkways, and the energy infrastructure of the island [46]. The same storm surge event submerged 100% of neighbouring Ellis Island. Out of the 1185 known CCH sites below 20 m in elevation in Puerto Rico, Ezcurra and Rivera-

Collazo [47] have identified 27 which are currently inundated at today's highest high tide. This is projected to increase to 56 by the mid-century, assuming a 0.6 m rise in sea level, with 140 sites to be inundated by the end-of-century should a 1.8 m rise in sea level occur [47]. In addition to high-profile sites, many smaller and less well-known forms of cultural heritage are also under threat. UNESCO estimates that more than 13,000 archaeological and historical sites on the Atlantic and Gulf Coasts will be at risk this century [48]. A one metre rise in sea level by 2100 would submerge thousands of archaeological and historic sites in the southeastern United States alone [48]. Furthermore, UNESCO indicates that more than 32,000 archaeological sites (including more than 2400 on the National Register of Historic Places) will be lost if a five metre or higher sea level rise occurs [48]. These figures include both pre-European settler archaeological sites and European contact/settler sites. It should be acknowledged that many of these cultural resources are Indigenous sites that have long been ignored in favour of lighthouses and more recent historical structures. However, the marginalisation of Native tribes is now recognised, and the study of Indigenous CCH sites holds tangible and intangible meaning for local communities and their histories [49,50].

In the U.S., the National Parks Service manages 1.8 million hectares of ocean, lakes, and reservoirs and over 69,000 km of shoreline. In its Directors' Policy Memo on Climate Change and the Stewardship of Cultural Resources, the NPS acknowledge the specific threats that climate change has on CCH and is seeking to: (1) gather, analyse and disseminate information regarding these impacts; (2) find ways to address the impacts through mitigation and adaptation techniques [51]. It is estimated that coastal assets, including infrastructure and cultural resources within the coastal units of the United States National Park Service (valued at over USD 40 billion), will become at risk from the impacts of climate change by 2100 [51]. Most importantly, without prompt and decisive action, grounded in accurate understandings of climate–coastal dynamics, many of these resources—and the meanings and values associated with them—are at significant risk of irreparable damage. A review of a study conducted by Fatorić and Seekamp [11] revealed that research specific to managing cultural resources under changing climate conditions is emerging and still in its infancy. Consequently, studies investigating the immediacy, impacts, and management responses—including both mitigation and adaptation—is urgently required if cultural assets in the coastal zone are to remain [13,19].

In the U.S., state, local, or federal jurisdiction could apply to preserving cultural heritage sites and structures depending on where a historical site is located or how its protection and management is funded. Further exacerbating the complex regulatory system in the U.S. is the lack of a national vulnerability index for heritage sites, resulting in an absence of national baseline data to guide how and where to focus preservation efforts more efficiently [52]. The lack of a vulnerability index at the national level is primarily because many individual states lack a comprehensive inventory of heritage structures, something that is problematic given that heritage programmes and disaster response efforts are most often handled at the state level [52]. The National Historic Preservation Act of 1965 (NHPA), while not the first law passed to address the preservation of historic sites and structures, did provide a comprehensive system to ameliorate the appointment of state, federal, and tribal jurisdictions [52,53]. The NHPA established the Advisory Council on Historic Preservation, which guides the president and Congress on preservation matters and charges federal agencies responsible for considering the impact their activities could have on cultural heritage sites. The establishment of the National Register of Historic Places in 1966 resulted from the NHPA providing an inventory of National Historic Landmarks. According to the U.S. Federal Emergency Management Agency (FEMA), any mitigation efforts undertaken must consider the impact on historic places [54]. The U.S. regulatory context takes a predominantly preservation perspective. In this article, we maintain that this is not sustainable and that adaptative heritage management approaches are required to address the challenges CCH sites face from climate change.

2.4. Heritage, Adaptation, and Climate Change

In Western contexts, approaches to cultural heritage have been dominated by the notion of 'preservation'. This has its origins in the 'Venice Charter' of 1964, which both formalised existing practice, but also proved to be foundational in defining a philosophy for heritage management practice which was widely adopted, particularly in European/American contexts [55]. The approach proposed by the Venice Charter prioritises "authenticity and integrity" [56] (p. 76). It emphasises preserving the fabric and appearance of a historic building in as close to its original condition as possible. It is an approach that is underpinned by "a constant concern for the preservation of the original material evidence in heritage resources", as discussed by Jokilehto [56] (p. 73). This 'preservationist' approach also seeks to prevent or minimise change and is generally sceptical of attempts to find a contemporary use for such heritage resources. Ashworth [57] (p. 8) summarises this approach as "first save, then maintain and only then, if possible, reuse". The effect is that heritage resources can become fossilised since their evolution as living buildings is effectively stopped [57]. This approach to the management of cultural heritage resources continues to be dominant in some parts of the world, although it is increasingly challenged by alternative and more dynamic perspectives which allow for change [56], such as 'adaptive reuse' [58].

Perry [59] states that every world heritage site is at risk from climate change, yet the scope and nature of that risk varies widely between sites. Thus, climate change adaptation is, itself, a 'wicked problem'; that is, there are no clear-cut solutions, and stakeholders at each site disagree on values, norms and first steps, making adaptation difficult [59]. Perry and Gordon [60] comment that heritage protection guidance, such as Article 3 of the Burma Charter in Australia, suggests that management approaches enact "as much as necessary but as little as possible" to conserve site attributes. Such guidance poses significant challenges to the philosophy and practice of heritage management, as all sites are subject to landscape evolution and impacts from global environmental change [61]. Importantly, as site conditions change, the attributes that underline the heritage designation may be lost, which may lead to reconsidering the site's heritage quality [62]. Conserving historic values is characteristically a western view towards heritage sites, while African perspectives view them as active sites in which heritage is continually being created and lost [60]. The distinction between static and dynamic heritage is important to note, especially when framing adaptive management, as conditions and values change to prepare reactive and proactive strategies [60,61]. While most management responses are reactive, attempting to replace lost values rather than being proactive about potential future values [11,59,63], proactive management responses involve assessing risks to the values of the site and adapting management strategies accordingly [60].

The dynamic nature of landscapes and the heritage sites within them demands a management approach that is cognisant of, and responsive to, change [63]. Given that heritage sites are firmly located within biophysical patches and their values are social constructs, Perry and Gordon [60] therefore argue that heritage is a complex socio-ecological system. The most effective approach to understanding and managing socio-ecological systems (SESs) is, according to DeSilvey [64], through adaptability, resilience, and transformability. Transformability is central to adaptive heritage through an SES lens. As biophysical and socio-economic conditions change, heritage sites follow new trajectories with attributes that may not meet the original criteria for site designation, i.e., it transitions to a new state [60]. The SES approach is forward looking, applying visioning and scenarios to consider future values and biophysical condition. An iterative and adaptive approach advances learning to a point where total understanding of changes is impossible and planning, acting, monitoring, and improving the management of heritage sites requires experimentalism [60].

Flannery et al. [15] extend the debate around the nature of resilience and adaptive heritage to incorporate the complexity of heritage's socio-political contexts, and they reconceptualise CCH management by reconsidering its temporality. Approaches to the manage-

ment of coastal and marine cultural heritage are dominated by a preservationist approach, underpinned by a view that such heritage should be conserved and maintained in its original state for future generations [15]. However, they argue for an alternative approach which accepts and embraces change and evolution rather than placing the emphasis on the 'present' state of CCH. They propose four types of "socio-temporal manifestations" [15] (p. 440): extant heritage, lost heritage, dormant heritage, and potential heritage. These are not absolute categories but rather a matter of interpretation [65]. Furthermore, they do not follow a determined pattern of chronological development.

Extant heritage is that which is currently recognised as being heritage. It is acknowledged by communities as being part of their (or other's) cultural heritage. In both tangible and intangible forms, it grounds community and place identities and is the subject of active preservationist projects so that it can be passed in its current form for future generations. Lost heritage is a form of tangible heritage which has been lost to coastal processes such as flooding or rising sea levels. It may be accompanied by the parallel loss of intangible practices and ways of life. While there is an awareness that it once existed, it can no longer be preserved for the benefit of future generations. Dormant heritage is predominantly tangible; it has been preserved and protected but is not accessible to the public. As such, it is known of, but not used. Nevertheless, it has the potential for reactivation through community activism. Finally, potential heritage consists of current tangible resources or intangible practices which are not currently recognised or valued as heritage but which have the potential to be considered as heritage in the future.

Flannery et al. ([15], p. 441) develop this analysis further through what they term "steering processes"; that is, approaches to the use and management of CCH. They propose three such processes. "Continuity steering" is dominated by the preservation model. It seeks continuity through maintaining the current form of CCH and seeks to protect it in a largely unaltered state from threats and risks. "Discontinuity steering" (p. 442) takes the opposite approach. It recognises that CCH may change due to processes such as coastal erosion so that it potentially becomes dormant or lost. This perspective is about anticipating and managing loss as a form of adaptation that can bolster community resilience through strengthening the community's ability to absorb change. It can, however, be an approach which excludes heritages that are considered marginal, subaltern, or otherwise unimportant. A third approach is "transformative steering" (p. 442). This is more productive in nature and focuses on adapting CCH so that it remains usable by a community, albeit in a different form. It may, for example, consist of maintaining a heritage in a digital or oral history format. It potentially creates a new heritage from existing resources. All three strategies can be applied to both tangible and intangible heritages, although achieving support and legitimacy among local communities and stakeholders may involve particular challenges. For example, heritage managers face various institutional, technical and financial barriers, particularly lack of processes and guidelines for planning and implementing climate adaptation measures [66]. Xiao et al. [67] indicate there is a need to develop decision support tools that facilitate the preservation of historic resource values, accounting for the influences of adaptation on historic resource values, the timings of those actions, and the tradeoffs among resources and fiscal decisions, thus moving beyond vulnerability assessments to integrate cultural significance and use potential and costs to provide opportunities for making tradeoff decisions about which cultural resources to prioritise for adaptation [67]. Figure 1 presents a summary of both the different types of heritage and the steering processes which can guide their management.

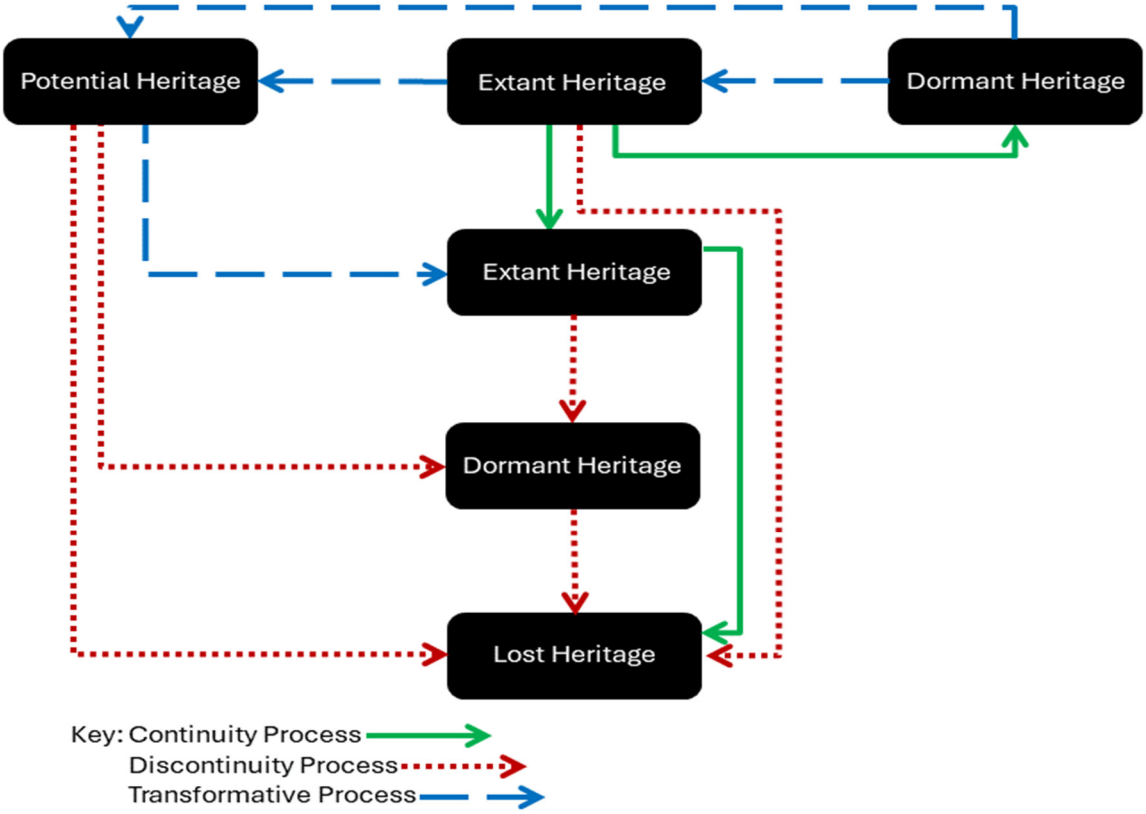

Figure 1. The cultural–temporal forms of coastal and marine cultural heritage and socio-political steering processes, adapted from [15].

3. Climate Impacts on Coastal Cultural Heritage in the US: Illustrative Examples

In this section, we examine the potential impacts of climate change (particularly rising sea levels) on tangible CCH in the eastern United States. We do so with reference to five examples which were chosen to illustrate different socio-temporal manifestations of heritage and different steering processes (continuity, discontinuity, or transformation). These examples were purposefully selected based on maximum variation principles [68,69] and were intended to demonstrate different responses to climate change. However, no empirical data are presented and the examples selected are based on interpretation of secondary data sources. Data sources included within this paper included the secondary academic literature and contemporary 'grey' literature (including news articles, policy documents, organisational, and community group literature). The examples presented are intended to be illustrative, but we do not claim that they are definitive or paradigmatic [70]. The five examples presented are intended to illustrate the most common ways in which tangible CCH can respond to the challenges of climate changes. However, there may be other types of response which are not embraced by the examples which we present. Thus, the five examples were selected to address the research question that has prompted the investigation, and the analysis of collective cases is intended to capture the complexity of the elements being studied [71–73]. With respect to the selection criteria for this article, specific examples of tangible CCH sites that are at risk from climatic impacts are presented in the following section.

The examples considered in this section are as follows: (1) Boston, which illustrates a continuity management steering process based on extant heritage; (2) Cape Hatteras Lighthouse, which illustrates transformation/continuity management based on extant heritage; (3) New York Harbor, which illustrates transformative management based on dormant heritage; (4) Miami Beach, which demonstrates poorly defined continuity management based on extant heritage; and (5) Atlantic City, an example of as yet unrecognised, potential

heritage which is currently on a discontinuity trajectory due to lack of management and steering processes.

There is value in reflecting on the methodology applied in this study. For example, this article utilising examples based on secondary sources rather than primary data collection can be perceived as a limitation. While primary data collection is beyond the scope of this study, further research may seek to build upon our findings by incorporating how, and to what extent, heritage managers are implementing adaptive management strategies. Key informant interviews with heritage managers, or those responsible for climate change adaptation in these areas (or others), could elucidate any debates and tensions surrounding how key CCH sites threatened by climate change are addressed. Furthermore, the examples that we have chosen are historic, post-European-settlement-built CCH sites. These sites represent only a portion of the tangible coastal cultural resources that are present on the eastern North Atlantic coastline. Other pre-European-settlement tangible and intangible CCH sites also warrant further study and attention.

3.1. Boston: Extant Heritage, Following a Continuity Management Process

Holtz et al. (2014) [74] lists Boston, Massachusetts, as one of the oldest cities in the United States, the birthplace of the American Revolution, and a city under significant threat from climate change. There are multiple forms of extant coastal and maritime heritage in the City of Boston. These include Faneuil Hall, the Union Oyster House, and Blackstone Block—a compact district of narrow winding roads dating back to the 17th Century. However, these are all vulnerable to flooding since they lie within the city's 100-year tidal flood zone [74–77]. These sites are significant for national identity in the U.S. since they are central to the emergence of American Independence. For example, Faneuil Hall is where Samuel Adams and other Sons of Liberty planned protests against British colonial policies, which prompted the Boston Tea Party of 1773 [78]. Furthermore, there are several nationally significant CCH assets located around Boston Harbor, including the Boston Tea Party Ships and Museum, the USS Constitution, and Charlestown Navy Yard.

Boston's heritage assets are managed by several organisations. Boston National Historical Park, designated in 1974, includes eight heritage sites, four of which are owned and operated by the National Park Service (NPS). Other assets, such as the Boston Tea Party Ships and Museum, are owned by Historic Tours of America, a commercial operator. However, the issue of adapting to and mitigating climate change within Boston largely falls to two organisations: Boston Harbor Now (formerly the Boston Harbor Association and Boston Harbor Island Alliance), a non-profit organisation that focuses on climate change preparedness; and the City of Boston, which developed the Climate Ready Boston initiative. The Climate Ready Boston report [79] predicts increased extreme heat events, increased frequency of storms, higher precipitation levels, and a sea level rise of 0.8 m by 2070. Approximately 30% of the city of Boston is less than 2.3 m (7.5 ft) above the mean high water, and subsidence further contributes to the problem of low-lying land [80]. Coastal flooding in the metro Boston region generally arises from extra-tropical storms known as "nor'easters" [75]. Furthermore, coastal Massachusetts has been sinking at the rate of 1.5 mm/year, or nearly 15 cm (6 inches) over the past century [75,80]. In their projection of flooding incidences, Kruel [80] identifies that a 1.1 m increase in sea level rise would result in 618 minor flooding occurrences and two major flooding incidences per year. A 1.8 m increase in sea level rise would see minor flooding incidences rise to 705 and major flooding occurrences increase to 251 per year [80]. This has substantial economic implications, the cumulative 2000 to 2100 damage and adaptation costs of coastal flooding in the metro Boston area could range from approximately USD 6 billion to USD 94 billion [75].

Berger et al. [81] (p. 10) claim it is Boston's history as a port city which has impacted its resilience to climate change, noting that the city's waterfront development and the associated reclamation of marshes and mudflats has resulted in "a massive loss of resilience protection". Climate Ready Boston [82] has developed a series of adaptation plans, including elevated roadways and walkways, tidal gates, seawalls and flood barriers, elevated

waterfront parks, and the restoration of marshlands. However, while the National Park Service's Climate Change Response Strategy [83] (p. 15) acknowledges climate change adaptation as one of its key objectives, the NPS approach to adaptation appears to be firmly rooted within a preservationist paradigm, with the report making reference to the 'protection', 'restoration' and 'recovery' of resources from climate change critical incidents. Indeed, many of the NPS's heritage assets within Boston (including Faneuil Hall Great Hall, Bunker Hill, and Dorchester Heights Monument) are currently undergoing restoration work. Therefore, while the wider city of Boston actively prepares for climate change adaptation, many of Boston's CCH sites are adopting a continuity steering process in which the preservation of existing structures in substantially their current form is a priority. It is an approach which may not be tenable in the longer term.

3.2. Cape Hatteras Lighthouse: Extant Heritage, with a Transformation and Continuity Management Process

The stretch of the eastern USA coast, from Cape Hatteras in North Carolina up to Maine, has experienced some of the fastest rates of sea level rise in the world—two to three times faster than the global average [84,85]. Cape Hatteras Lighthouse is located in Buxton on the Outer Banks of North Carolina and is one of America's most famous landmarks. When it opened in 1870, it was the tallest brick building in the world, and it remains the tallest brick lighthouse in the U.S. [86]. As a National Historic Landmark, the lighthouse is of national importance and forms a key part of one of the USA's 10 National Seashores. As such, Cape Hatteras Lighthouse can be considered as 'extant heritage' due to its recognised importance as national heritage [15].

Cape Hatteras Lighthouse has been owned by the National Park Service (NPS) since 1937, and the organisation has faced the ongoing issue of coastal erosion at this site since this time. In 1999, the scale of coastal erosion necessitated the relocation of Cape Hatteras Lighthouse and the keepers' quarters at 883 m, with the structures now lying 457 m from the seashore (its original distance from the shoreline) [74,87–89]. Kim [89] claims that the NPS pursued a preservationist approach, considering ten different proposals to conserve the lighthouse. The strategy adopted was to relocate the lighthouse, which can be considered as a form of "transformative steering process". It represents the "adaptation of heritage so that it continues, in a different format, to be usable by a community" ([15], p. 442). Therefore, while the function of the lighthouse remained unchanged, its format—in a new location—was radically altered. However, Kim [89] argues that local residents preferred the strategy of beach renourishment, as they viewed relocating the lighthouse as diminishing it as a symbol of strength and stability. Nevertheless, the relocation of the lighthouse has enabled its continued community and touristic use, although it is currently undergoing a significant 18-month restoration project, with public access due to resume in 2026 [86].

Despite the transformative relocation of Cape Hatteras Lighthouse in 1999, the NPS has subsequently pursued a "continuity steering process" [15]. While the USD 12 million move inland provided a predicted 100 years of protection from the eroding coast [89], more recent research indicates that further adaptation measures will be needed to protect the CCH assets at Cape Hatteras National Seashore due to the risk of hurricanes, storm surge inundation, and sea level rise [90]. Therefore, in order to maintain the lighthouse and other extant heritage at Cape Hatteras, the NPS may need to return to a transformative steering process in the near future.

3.3. New York: Dormant Heritage, Following a Transformative Management Process

During the late nineteenth century, New York Harbor was one of the busiest ports in the world, yet by the end of the 20th century the city of New York had turned its back on the Hudson River. It is in this context that, like many other coastal cities [91], New York rediscovered its CCH and recognised the economic, social, and health benefits of reconnecting with its waterfront [92]. The city passed the Hudson Park River Act in 1998, which aimed to develop a new public park and wildlife sanctuary along several kilometres

of the Hudson River estuary [93]. A prominent feature of the proposed park were the piers, which had been a key part of the city's port function.

The potential of NYC's industrial coastal heritage, and specifically its piers (numbering approximately 100 along the Hudson estuary alone) had remained dormant, with many being in a state of disrepair and decay due to boring by marine organisms [94]. The Hudson River Park Trust (HRPT) vision followed a "transformative management process" to rejuvenate and repurpose over 20 piers alongside other key waterfront areas along the peninsula [94]. Today, the Hudson River Park features iconic leisure facilities and visitor attractions, including Pier 54 (also known as 'Little Island'), which has been transformed into a maritime botanic garden and outdoor amphitheatre, and Pier 26, which features five ecological zones reflecting the natural heritage of the area prior to human habitation.

Gornitz et al. [95] note that the Hudson River Park is an important part of NYC's wider strategy to build climate change resilience in the face of projected SLR of 2.1 m by the 2080s, potentially reaching 2.9 m by 2100. Along with other flood protection measures, the 'New York City Comprehensive Waterfront Plan' aims to restore natural habitat and enhance climate resilience through the development of 'green infrastructure', which acts as a flood buffer zone. The development of the 'Tide Deck' at Pier 26, an area of replanted salt marsh grass, is one example of 'green infrastructure' within the Hudson River Park. As such, the park has not only succeeded in transforming and revitalising NYC's dormant industrial coastal heritage but has also improved the city's resilience to the impact of climate change. This illustrates the productive nature of transformative CCH steering processes, which have created new resources for leisure and new environments which enhance local biodiversity.

3.4. Miami Beach: Extant Heritage, Following a Poorly Defined Continuity Management Process

Miami Beach contains one of the largest assemblages of Art Deco buildings in the world, built between the 1920s and 1940s. These include approximately 800 buildings located along, and inland from, Miami's seafront Ocean Drive, covering approximately one square mile (1.6 square kilometres). The move to recognise the importance of Art Deco architecture was led during the 1970s by the Miami Design Preservation League (MDPL), which conducted campaigns and events to raise awareness of the Art Deco structures associated with Miami Beach's heritage as a resort. In 1979, the MDPL successfully gained recognition for the Miami Beach Architectural Historic District (also known as the Art Deco District), which became the USA's first 20th century urban Historic District and was listed on the National Register of Historic Places [96–98].

Nevertheless, as noted by Fleming [96], achieving a National Register of Historic Places designation did not result in the preservation or conservation of such sites, and several notable buildings in the Art Deco District were demolished during the 1980s. At this time, Miami Beach was associated with dilapidated buildings, low-income residents, and crime, which was mirrored in its on-screen portrayal in the television series *Miami Vice* [99]. It was not until 1992 that the MDPL achieved Planning Board approval for historical preservation of the Art Deco District, restricting the demolition of buildings within the area [98].

Over the last four decades Miami's Art Deco District has become renowned on a national and international basis. It has become established as a tourist destination and aspirational residential area, making the area valuable real estate. However, this has often taken place at the expense of the district's lower-income, minority, Jewish, and LGBTQ+ populations [97,99], whose histories and heritage are often reduced to footnotes in the district's visitor attractions and tours. With the rejuvenation of domestic and international tourism demand, Miami's Art Deco District heritage buildings have been regenerated and restored to their original function as hotels, beach and nightclubs, boutiques and restaurants. Despite the value and recognition now afforded Miami's Art Deco District, the area faces significant threat from climate change, with Miami identified by the U.S. National climate assessment as the economically most vulnerable city to sea level rise in the world [100]. The accelerated rate of sea level rise in Southeast Florida—9 ± 4 mm/year since 2006 (increasing from 3 mm/year prior to 2006)—is mostly due to high tide events and is significantly higher

than the global average rate, estimated at 2.8 mm/year [100]. Extensive nuisance flooding events occurred in September and October 2015 in Miami, with excessive tidal flooding underestimating sea level by 23 cm in Miami [84,101]. Offshore conditions associated with Hurricane Joaquin in the same year also exacerbated flooding conditions in October 2015 [84,102]. It is estimated that flooding events of this magnitude may occur in Miami around every 6 years given matching environmental conditions observed in September and October in 2015 [84,101].

The Art Deco architecture of Miami Beach represents a transition from potential to extant CCH [15], which is now highly valued. Indeed, many of the buildings are now used for purposes that mirror those for which they were originally constructed. However, the MDPL and other stakeholder organisations (Miami Beach City Commission, Florida Trust for Historic Preservation, and City of Miami Beach Historic Preservation Board) continue to protect Miami's Art Deco tangible cultural heritage from the threat of redevelopment and demolition, and therefore follow a "continuity" steering process. Whilst this preservation approach has ultimately been successful in protecting the Art Deco District from anthropogenic threats, the continuity process may not be sustainable in meeting the challenges posed by climate change. The City of Miami Beach's 'Rising Above' (MBRA) project has been hailed for its innovative approach and resilience to climate change, with adaptations including extensive deployment of groundwater pumps, raising key infrastructures, such as roads, and the building of sea walls. However, Wakefield [103] (p. 41) criticised the MBRA project for attempting to maintain the cityscape and socio-economic *status quo*, terming it "back loop urbanism" with the ultimate goal of "cocooning the Miami Beach 'forever' in a perpetual present of luxury housing and profit". Ultimately, Miami's continuity and preservation perspective on a long-term basis will make this coastal city and its Art Deco heritage vulnerable to climate change impacts in future.

3.5. Atlantic City: Potential Heritage, Currently Following a Discontinuity Process

Atlantic City was originally a coastal resort which developed in the 19th century and enjoyed considerable popularity as one of America's premier resorts for mass tourism and leisure. This created a distinctive urban landscape that is dominated by buildings created for the tourism industry. However, like many other coastal resorts around the world, the 'Queen of Resorts' and the 'nation's playground' Atlantic City became increasingly uncompetitive as other resorts, such as Disneyland, became fashionable for domestic short-stay holidays [104]. It experienced economic decline in the 1960s and 1970s along with a rise in social deprivation. Many parts of the resort's cultural heritage assets (particularly hotels) were demolished or converted to other uses (thus representing a form of lost heritage).

Struggling with its declining fortunes, Atlantic City was reimagined and regenerated by the 1970s Casino Referendum, which resulted in the demolition of many of the traditional seaside buildings, such as the Windsor Hotel, Traymore Hotel, Blenheim Hotel, and Chalfonte Hotel, to make way for mammoth casino buildings [105]. However, as Simon [104] notes, the use of casinos for the regeneration of Atlantic City was not entirely successful, for while visitor numbers to the resort during the 1990s placed Atlantic City as the most visited destination in the USA, those visiting stayed only a matter of days or hours to enjoy the facilities offered by the casino resorts. As such, the decline of Atlantic City as a long-stay holiday destination mirrored the fate of many other cold-water seaside resorts [106], as, with the resort's visitors being ensconced within the casino resorts, the resortscape now has "some of the loneliest, most desolate streets in all of America" [104] (p. 12). With the loss of much of Atlantic City's community, there are few who might champion the protection of the resort's tangible heritage, resulting in largely unrecognised or potential CCH assets.

Today, relatively few of the CCH assets associated with Atlantic City's past as a seaside town are recognised as heritage. These include the Atlantic City Convention Hall (or Boardwalk Hall) and a number of buildings which represent lost heritage through being demolished (such as the Morton Hotel and Holmhurst Hotel) [107]. Many other

examples of Atlantic City's CCH assets do not enjoy statutory recognition or protection. These include the world's largest boardwalk (constructed during the 1870s); the resort's four remaining piers (Central, Steel, Playground, and Garden); original hotels (including the Dennis and Claridge Hotels) and arcades (such as the Bally's and Playcade arcades). Furthermore, non-statutory conservation bodies appear to be reluctant to embrace the heritage of the seaside holiday (see [8] on the 'neglected' heritage of mass tourism seaside resorts in the UK). This therefore represents a form of potential heritage that has yet to be recognised or valued.

Despite the significant investment in Atlantic City's resort casinos in the 1970s, plans for adaptation and mitigation of the impacts of climate change and sea level rise have been *ad hoc* at best [108,109]. New Jersey's Department of Environmental Protection only published its first Climate Change Resilience Strategy in 2021. Kopp et al. [110] predict a likely sea level rise of between 30 and 50 cm in Atlantic City by 2050, resulting in increased inundation, flooding, and coastal storms. While Atlantic City's tangible heritage of mass tourism remains unrecognised, there are no specific strategies for the adaptation of these heritage assets. As such, Atlantic City's distinctive historical architecture of mass tourism is subject to a *de facto* discontinuity steering process [15] in which it is not currently recognised or valued as CCH. It is a form of potential heritage that is in danger of being lost both due to climate change and an ambivalence regarding its heritage value.

4. Discussion

The examples examined above have applied the model developed by Flannery et al. [15] in embracing both the four social-temporal manifestations of tangible CCH (extant, lost, dormant, and potential) and the three social political steering processes (continuity, discontinuity, and transformation) whilst also considering the roles and policies of the stakeholder organisations which own and manage the heritage assets.

It is apparent that, with regard to these five examples, a preservationist paradigm is dominant, underpinned by continuity steering processes. This approach follows a traditional management approach which aims to preserve the originality, physical integrity, and authenticity of the historic resources [56]. This is particularly evident in Miami Beach and Boston Harbor (especially with those heritage assets owned and operated by the NPS). It is also illustrated to a lesser extent by Cape Hatteras Lighthouse, which experienced an episode of transformational change but has now returned to a continuity process, again influenced by the NPS's preservationist stance. Each of these examples is a form of extant heritage which, as Flannery et al. [15] note, grounds community identities and attachment to place. As such, a management approach which prioritises continuity is likely to be the most acceptable to local communities and other socio-political stakeholders. The two examples which did not take the form of extant heritage—New York City's Hudson River piers (identified as a form of dormant heritage) and Atlantic City's landscape of mass tourism (an unrecognised but potential future form of heritage) adopted different forms of steering processes, characterised by a higher degree of risk and much less concern for historical authenticity. In these examples, the socio-political context is important: the New York City piers are part of the Hudson River Park Project, spearheaded by the city authorities to transform the derelict waterfront industrial heritage, illustrating active 'communities of meaning' and 'communities of participation' [32]. Conversely, the limited value attached to the historic buildings of Atlantic City reflects an ambivalence among local stakeholders (inactive communities of participation and meaning), leading to a "discontinuity steering process" by default.

In terms of readiness for, and adaptation to, climate change, the examples based on extant heritage take different socio-political approaches. The 'Climate Ready Boston' strategy takes a proactive and environmentally sustainable approach to climate change adaptation. Conversely, the 'Miami Beach Rising Above' strategy is concerned with mitigating the impact of climate change and maintaining the *status quo* (underpinned by a preservationist approach). These differing socio-political approaches to climate change

could determine radically different socio-temporal manifestations for the tangible CCH of each city: Boston's heritage is likely to remain extant despite the impacts of rising sea levels, while Miami Beach's Art Deco District could be lost to the impacts of climate change. In the case of Cape Hatteras Lighthouse, the relocation of the building in 1999 represented a "transformational steering process" which successfully protected the heritage asset from the effects of rising sea levels. However, the return to a "continuity steering process" for the wider Cape Hatteras National Seashore (led by the National Park Service) is unlikely to prove sustainable in the face of the long-term effects of climate change. The building risks being destroyed unless further "transformational steering processes" are adopted in the future.

In the case of the dormant heritage represented by the New York Hudson riverscape, the environmentally sustainable process of adaptation has entailed utilising and redeveloping the cultural heritage of the waterfront in a way which has stimulated the local community to attach new value to this area of the city. The transformative actions adopted by the Hudson Park River Trust mean that the once-dormant heritage resources are now resilient against the impacts of future climate changes, as well as contributing positively to the city's wider adaptation to climate change. For this reason, New York's river piers and other structures will remain as extant cultural heritage in the longer-term. Conversely, Atlantic City has developed a somewhat *ad hoc* approach to mitigating the impacts of climate change. In this context, the future for the distinctive but unrecognised heritage of this seaside resort looks highly uncertain. If this heritage remains unvalued by conservation bodies, many forms of potential heritage could be lost to rising sea levels. This is a good illustration of what Flannery et al. [15] (p. 444) identify as the "erasure of marginalised community heritage".

The analysis presented above has demonstrated that the conceptual framework proposed by Flannery et al. [15] is of considerable utility in understanding current and future trajectories of CCH in the face of climate change and rising sea levels. Nevertheless, the model does have weaknesses, not least of which is the limited attention it gives to the socio-political approaches to climate change in which CCH and its associated steering processes are situated. Therefore, our analysis enables us to expand and develop the framework of Flannery et al. [15] to embrace the broader socio-political policies, priorities and practices of climate change adaptation and mitigation in each CCH location. A more nuanced understanding of CCH can be obtained through considering the nature of the tangible heritage resources themselves, the steering processes which determine how they are managed, and the socio-political approaches to climate change in which such heritage is situated and managed.

Figure 2 presents a model which synthesises the steering processes taken at the five examples of CCH, incorporating the socio-political approaches to climate change adopted in each locality. It further presents predictions concerning the future socio-temporal status of each tangible CCH site. We suggest that a consideration of steering process alone may not be sufficient to mitigate the effects of climate change; instead, an incorporation of the wider socio-political approaches to managing the impacts of climate change is an essential consideration. Embracing both CCH steering processes and wider socio-political approaches to climate change can inform and underpin stakeholder engagement in managing the future socio-temporal states of CCH.

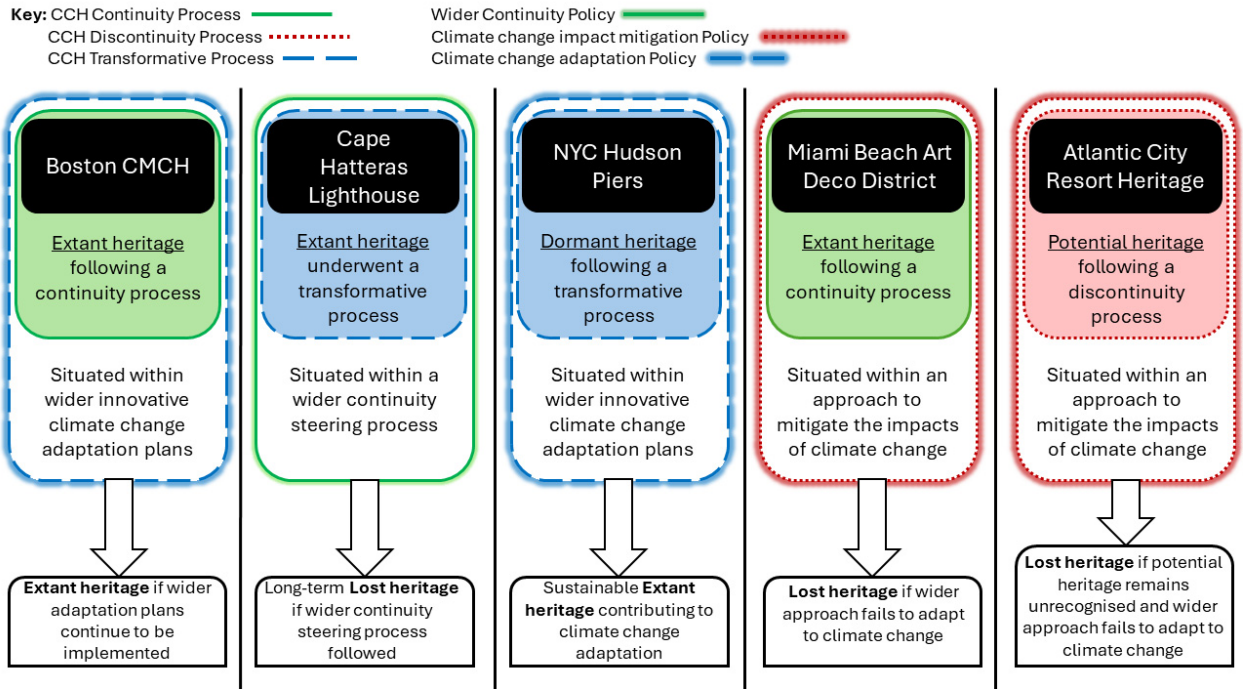

Figure 2. Revised conceptual model incorporating socio-political context in regard to shaping change to coastal cultural heritage caused by climate change (adapted from Flannery et al., 2022 [15]).

5. Conclusions and Implications

Anthropogenic climate change and human development pressures are increasingly threatening cultural heritage, cultural resources, and the communities and people that benefit from them. Sea level rise, storm surges, and more intense Atlantic hurricanes are a substantial threat to tangible CCH sites in the United States [74,77,111,112]. The examples in this article illustrate many challenges facing post-European-settlement-built tangible CCH sites in the United States because of accelerating climate change. Many CCH assets along the eastern coast of the U.S. are already facing substantial damage and/or destruction, with some cultural resources being relocated and protected while others have been left to decay [14,17,74].

In this paper, we have identified various ways in which the management of CCH can respond to climate change. In particular, we have argued for the need to move beyond the preservationist approach, which accords priority to the integrity and authenticity of historic resources. Our findings are reinforced by Seekamp and Jo [113] (p. 43), who argue that "heritage scholars are musing about the need to rethink the traditional preservationist paradigm (i.e., the static state conservation of tangible heritage attributes) and its associated policies given projected impacts to tangible heritage resources and intangible values, the diverse and dynamic manifestations of those values, and the likelihood of loss from changing climatic conditions". Seekamp and Jo [113] argue that the heritage field needs to adopt an ecological framework of resilience to expand the preservationist paradigm in a way that enables persistent adaptation, anticipatory adaptation, and autonomous adaptation. Drawing on the model proposed by Flannery et al. [15], we have highlighted the role and significance of different steering processes through which managers of CCH respond to the threats of climate change. While these steering processes are undoubtedly a useful conceptual tool, we argue that there is also a need to consider the wider socio-political approaches to climate change in which these processes unfold.

At the present time, the impacts of a changing climate are, and are projected to, occur over a wide range of physical and socio-economic contexts; it is therefore a multi-scalar problem that is too large for any one organisation (or discipline) to tackle. Our emphasis on understanding socio-political approaches to climate change points to the necessity for multi-

agency and multi-level stakeholder approaches to address such challenges. For those sites that are following a continuity trajectory, forming a multi-agency partnership, sharing data, and collaborating to effectively and immediately protect and manage CCH sites are the first steps needed for sustainable coastal management [114]. For CCH resources following a discontinuity process, a priority will be effective articulation and communication of loss to multiple stakeholders [9]. Where CCH assets are following a transformative trajectory, there is an opportunity to put CCH to new uses which contribute to climate change adaptations. In such cases, explaining the advantages of change to all affected stakeholders is a priority.

We, therefore, assert that both active and passive adaptive heritage management approaches be implemented when addressing the impacts of climate change on CCH [59–61,115]. The need for proactive and reactive management responses that take into account the dynamic nature of heritage and its fluctuating cultural values, as well as the biophysical sites featuring CCH, is essential to an adaptive management approach [11,59,60,63]. Consequently, adaptive heritage management will inevitably have wider implications for coastal and ocean governance, specifically the management approaches addressing climate change impacts on the coast. There is a need to recognise and incorporate the socio-cultural and socio-political contexts within management approaches [15,65]. A concerning challenge associated with addressing climate change at CCH sites is the increasing polarisation, and politicisation, that climate adaptation and coastal resilience issues face in the United States. Conservative State legislatures have become less likely to endorse and enact adaptation strategies [116]. Consequently, adaptive coastal heritage management, if deemed important, cannot be left to local governments and organisations that may not have the resources to address the climate impacts on local CCH sites.

There are many avenues for further study that future research can delve into. We suggest that, building upon our study, further research may apply key informant interviews with heritage managers to explore the extent to which adaptive coastal heritage management strategies are employed and implemented in distinctive CCH processes (as shown in Figure 2). While our study has focused on the risk of climate change on post-European-built tangible CCH sites, further studies should expand this research to explore each risk highlighted by Ounanian et al. [32] on both tangible and intangible pre-European and post-European CCH sites. Furthermore, our research has explored the climate impacts on CCH sites along the eastern coast of the United States. While there are inherent limitations with this focus, further research should be expanded to other geographical contexts (e.g., the Global South) and socio-cultural contexts (e.g., Indigenous communities).

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