Coastal heritage, global climate change, public engagement, and citizen science

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Edited by Daniel H. Sandweiss, University of Maine, Orono, ME, and accepted by Editorial Board Member Dolores R. Piperno January 13, 2020 (received for review August 14, 2019)

Climate change is threatening an uncalculated number of archaeological sites globally, totaling perhaps hundreds of thousands of culturally and paleoenvironmentally significant resources. As with all archaeological sites, they provide evidence of humanity's past and help us understand our place in the present world. Coastal sites, clustered at the water's edge, are already experiencing some of the most dramatic damage due to anthropogenic climate change, and the situation is predicted to worsen in the future. In the face of catastrophic loss, organizations around the world are developing new ways of working with this threatened coastal resource. This paper uses three examples from Scotland, Florida, and Maine to highlight how new partnerships and citizen science approaches are building communities of practice to better manage threatened coastal heritage. It compares methods on either side of the Atlantic and highlights challenges and solutions. The approaches are applicable to the increasing number of heritage sites everywhere at risk from climate change; the study of coastal sites thus helps society prepare for climate change impacts to heritage worldwide.

archaeology | coastal heritage | climate change | heritage management | citizen science

Coastal environments have long been favored for human settlement, providing access to resources, transportation, trade, and defensible locations (1). Millennia of coastal occupation have produced a wealth of archaeological sites, including evidence of African Middle Stone Age (125,000 to 40,000 years ago) activity (2) and sites from the Terminal Pleistocene (11,000 years ago) on the South American coast (3). Intervening time periods throughout the Holocene document indigenous activity and colonial occupations, with some sites specific to maritime activities, but many others reflecting society as a whole. These irreplaceable cultural and paleoenvironmental resources contain valuable information for archaeology and wider society (4, 5), but are under severe threat from the development of coastal regions, environmental degradation, and the impacts of anthropogenic climate change leading to an acceleration of natural erosive processes.

Coasts are dynamic areas subject to a range of forces and natural processes. Cliff and dune erosion, flooding, and inundation put archaeological sites at immediate danger of destruction (Fig. 1). Valuable information is being lost to the sea, and urgent calls for action to rescue data from the most vulnerable sites have led coastal archaeologists to develop new ways of working: involving citizens in projects and building partnerships that record the threatened resource. Evolving decision-making and management tools for vulnerable coastal heritage are widely applicable to all threatened heritage. These methodologies will become increasingly important as greater numbers of sites, in a range of environments, are threatened by the impacts of climate change.

An archaeological site's vulnerability (6) is determined by its exposure (the scale of the potential impact of a climatic event) and its sensitivity (or degree to which it could be affected by that exposure). At the coast, climate impacts result from sea-level rise (SLR), increasing wave height (7), and changing weather patterns, all factors that multiply existing stresses. Some effects, such as inundation, collapse, or even the destruction of sites are immediately visible, while indirect

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Author contributions: T.D., J.H., A.K., W.L., and S.M. performed research and wrote the paper.

Competing interest statement: A.K. and D.H.S. are both affiliated with the University of Maine.

This article is a PNAS Direct Submission. D.H.S. is a guest editor invited by the Editorial Board.

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This article contains supporting information online at https://www.pnas.org/lookup/suppl/doi:10.1073/pnas.1912246117/-/DCSupplemental.

First published April 13, 2020.

Fig. 1. Newark Castle in Fife, Scotland, with the remnants of buildings adhering to the cliff face.

challenges, such as the looting of places revealed during storms (8), also threaten important resources. Coasts are, therefore, among the first and most noticeable places to show the effects of climate change on heritage in contrast to a number of other climate impacts affecting heritage sites that are subtle and occur over the longer term (9, 6).

Climatic events can force us to consider how to react in the future: for example, storm surge damage associated with Superstorm Sandy supports calls for preemptive archaeological salvage (10, 11). Nonclimatic events also help with planning, such as damage caused by the 2011 tsunami in Hawaii (12) used as a proxy for what may become the norm due to SLR and increasing storm intensity. The effects of the Hawaiian tsunami have been incorporated into models used to manage coastal heritage, indicating that a 0.5-m increase in sea level will triple or quadruple the number of sites susceptible to erosion or inundation (12).

Past events, climate risk assessments, and coastal vulnerability studies show that large numbers of sites are threatened (13, 14). Heritage managers need to make conscious and justified decisions about taking action—or not (15). Loss should not happen by default; as stated in the National Park Service (NPS) Cultural Resources Climate Change Strategy (ref. 6, p. 42), "taking no action is a decision" that will, for many sites, lead to the destruction of the resource.

The urgency of the climate threat has prompted heritage agencies around the globe to develop strategies for the preservation and monitoring of coastal heritage resources (8, 16), with many recognizing the need to prioritize the use of resources. For example, in 1995 (17), a published workflow for Scottish coastal sites included identifying the impacts of coastal processes, undertaking rapid coastal surveys in vulnerable areas, creating a list of priority sites, and implementing appropriate solutions at some sites. In the United States, the NPS director issued a policy memorandum (18) setting out a work progression of understanding the significance and condition of historic assets, assessing their vulnerability to different threats, and appraising the feasibility of options for either addressing these or dealing with loss. It urged heritage managers to make decisions "directed to resources that are both significant and most at risk" and to target vulnerable areas that had not yet been inventoried (18). The initial calls on both sides of the Atlantic urged heritage managers to understand both the resource and potential threats, a recommendation grounded on "the basic tenets of resource management" (19).

Typically, the first step has been to gather, update, and analyze survey data to provide the basis to guide decisions. For example, Historic Scotland (now known as Historic Environment Scotland [HES]) first sponsored dedicated coastal heritage surveys in the 1990s. The methodology involved teams of archaeologists searching a 50-m-wide coastal corridor and reporting on heritage discoveries while assessing vulnerability, including "on-the-day" observations on the erosional state of the coast. SCAPE (Scotland's Coastal Archaeology and the Problem of Erosion), based in and working closely with the University of St Andrews, started managing the surveys in 2000. By 2011, about 30% of the coast had been investigated, recording over 12,500 coastal heritage sites (20). Coastal heritage surveys have also been conducted in the United States (21), and some US Atlantic Seaboard states commissioned specific surveys after Superstorm Sandy (11).

Coastal surveys on both sides of the Atlantic have located large numbers of previously unrecorded sites, even in areas previously examined. Before dedicated coastal survey on Block Island (Rhode Island), the few records of heritage sites led to low expectation of new discoveries, but many more sites were located than expected (11); while in some parts of Scotland, the number of coastal sites recorded within an area doubled after a survey. New erosional exposures partly explain this trend, and Milner (22) noted the irony of previously buried sites being discovered due to the process of destruction, with erosion exposing remains that are then vulnerable to rapid damage.

After completing inventories, the next step has been to prioritize vulnerable sites, as it is not feasible to take action at all of the numerous heritage assets threatened by natural processes. Central to prioritization is the idea of ranking sites on the basis of importance, although this requires agreement on what makes heritage valuable or significant (10). Fatorić and Seekamp (23) found that, in addition to the "immediacy of climate change threats," heritage managers identified the most important factors in prioritizing work as places with "high scientific value," "uniqueness or rarity," and "national importance." These three considerations are connected with the intrinsic value of the site. One seemingly simple way to identify value is to use existing designations of significance: for example, World Heritage Site status (24), sites listed on the National Register of Historic Places (the United States), or Scheduled Ancient Monuments (the United Kingdom). However, many qualifying sites will not meet designation criteria because of a lack of survey information or prior research (25). Additionally, local community members in Scotland participating in the Learning from Loss program (ref. 26 has a video containing participant interviews) noted that a wider set of values, including social and economic potential, should also be considered.

Working at the Coast—A View from Scotland

In 2000, growing awareness of the crisis facing Scottish coastal archaeology led HES to help establish a new organization. The SCAPE Trust, based at the University of St Andrews, was set up to create partnership projects with heritage managers, academics, and local communities. In 2010, SCAPE completed an analysis of all sites recorded in rapid coastal surveys. Each site's significance (including intrinsic value and other known values) received a weighted score based on the survey description (27). Vulnerability to damage from coastal processes was also scored, with the two scores multiplied to produce five priority categories; sites that were highly vulnerable and highly significant were ranked as greatest priority. The prioritization process involved two rounds of consultation with regional and national heritage managers. The process identified 322 highest priority places where urgent work was required from the 12,500 sites originally recorded, together with a further 618 sites that required attention.

Recommendations for action were also made, and one recommendation was that each priority site should be revisited to check condition. This provided an ideal opportunity to involve members of the public, building on Shorewatch, a community archaeology project coordinated by SCAPE from 2000 (28) that had demonstrated a strong public interest in coastal heritage. As many of the sites were located on islands, local people were ideally placed to monitor heritage, especially after storm damage.

SCAPE launched a new project, the Scotland's Coastal Heritage at Risk Project (SCHARP), in 2012 with funding from several organizations, including HES and the Heritage Lottery Fund. SCHARP had two strands. The first element, ShoreUPDATE, worked with the public to update information on the priority sites. The project involved making existing records available through a web-based, interactive "Sites at Risk Map" (29). Each site record acted as a portal from where the public could download information and survey forms. The interactive map also formed the basis of the ShoreUPDATE mobile app, which democratized participation by making data accessible using familiar technology and allowed new sites to be recorded. Volunteers downloaded records and maps onto their device and used global positioning system functions to navigate to sites, where they updated condition records and took photographs. They then uploaded completed surveys and images, which were validated before being added to the project database.

Between 2012 and 2017, over 1,000 records were updated. These documented considerable change since the mid-1990s, showing that some coastal sites had been damaged and that others had been destroyed. Analysis of updated records led to a revision of the prioritized list, with some sites retaining their priority status and others moving either up or down (i.e., they had been destroyed, stabilized, excavated, or analyzed) (30).

HES is one of the principal funders of work undertaken at threatened sites outside the planning process, and having a robust, prioritized list of vulnerable sites has assisted in directing resources. The project has also demonstrated that a citizen science project can provide meaningful data for heritage management. Similar projects have been initiated in other parts of the United Kingdom (31, 32), Europe, and the United States. However, differences in legislation and management practices mean that approaches vary from place to place.

A View from Florida

In 2015, the Florida Public Archaeology Network (FPAN), a statewide organization established in 2005 to help protect Florida's archaeological sites through education and outreach, began a new effort to engage the public and monitor at-risk heritage in Florida (33, 34). After 10 years of working with the public, increased awareness of global warming and SLR caused FPAN to consider how to address the climate emergency through education and outreach, assistance to local governments, and assistance to Florida's Division of Historical Resources (35, 36).

The Heritage Monitoring Scout (HMS) Florida program began as a series of SLR workshops in partnership with local planners. Staff from FPAN wanted to engage the public, who had limited opportunity for proactive involvement, to provide a larger role in protecting heritage from SLR and climate change. As staff piloted different exercises in measuring impact, they began to look at site stewardship programs that leaned toward recording impacts due to climate change. Influenced by SCAPE's SCHARP model, which fit the desire for a public, statewide approach, the HMS Florida program built on the success of other FPAN citizen science-based engagement programs, notably Cemetery Resource Protection Training and Heritage Awareness Diving Seminar (37, 38). Early pilots allowed FPAN staff to develop and refine monitoring forms, adjust workflow, and launch the program statewide in 2016 (39, 40). These projects further demonstrated the wide geographic reach of HMS Florida and the range of site types included in the program (*SI Appendix*, sections S1 and S2). In just a few years, sites monitored by the HMS Florida program displayed a faster than predicted rate of erosion. For instance, in less than 1 year following multiple storms and two hurricanes, FPAN staff documented 2.5 m lost at a multicomponent shell midden and historic farmstead site (Shell Bluff Landing) (41).

Major challenges to engaging the public to monitor sites at risk in Florida and other parts of the United States have included identifying threats, limited climate change literacy of Americans, restricted access to site location data, database issues, multiple and often overlapping ownership/jurisdiction of resources, data sharing and intellectual ownership, and inaction and inertia for coalition building.*

The benefits for heritage professionals and the public outweigh the challenges that they must overcome. HMS Florida brings to the state a focus on climate science for the public not widely available elsewhere. Teaching climate literacy and heritage preservation has also meant a considerable training investment for FPAN staff in emergency resource management and climate science and increasing the effectiveness of responses.

Database challenges for monitoring in the United States abound. First, because the state's archaeological site files only accept new site forms or major updates to existing reports, FPAN had to develop a "shadow" database to record results on monitoring activities. Second, information on site locations in American government files—unlike the United Kingdom—is generally restricted from open public access for fear of sites being looted (Fla. Stat. §267.135 [2018]), which poses an obstacle in engaging the public in site-monitoring activities. To release site location information, FPAN had to develop a vetting and oversight process for the program's citizen scientists. Third, ownership of sites and overlapping management jurisdictions add further complications for addressing sites at risk. In Florida, sites are owned by the federal government, state agencies, county and municipal governments, and private landowners. However, collaboration is on the rise as a coalition of archaeologists, preservationists, planners, and land managers—the Coastal Heritage at Risk Taskforce (CHART)—demonstrates the rising momentum to build consensus and coordinate a plan to address issues of prioritization and response to this growing crisis.

HMS Florida continues to gain momentum, with over 640 volunteers (monitoring scouts) who have submitted over 1,100 monitoring forms across the state (41–43). The program not only benefits the sites and the state but the participants as well (Fig. 2). In 2017, HMS Florida underwent an outcome-based evaluation and found that

*S. E. Miller, "Challenges and opportunities for the heritage at risk community." Annual Conference for the Society for Historical Archaeology, 11 January 2019, St. Charles, MO.

Fig. 2. HMS Florida benefits both the public in life condition and cultural resources by the monitoring of archaeological sites.

participants experience a life condition benefit from participating in the program and a feeling that they are making a difference.[†]

FPAN found solutions to initial challenges by learning from and partnering with international organizations, such as those highlighted here. Global partnerships help give the necessary scope and urgency needed to overcome coalition inertia. They provide examples of sustained case studies that can help persuade local and state governments that this work is worthy of the time and resources that it demands. Unlike public archaeology programs in the 20th century that had time on their sides, archaeologists can no longer afford gradual or independent development of approaches—we must build our local solutions on others' successes.

A View from Maine

The Midden Minders (MMs) effort was developed with support of Maine Sea Grant, the Senator George Mitchell Center for Sustainability Solutions, and the University of Maine Advanced Computing Group. The program grew out of a 2-day meeting of stakeholders in 2017 that included presentations, discussions, and a field trip to midden sites. Participants included the Maine Historic Preservation Commission (MHPC) staff, university researchers, conservation organization members (many managing coastal land), a tribal member, an avocational archaeologist, and representatives of UK initiatives, including SCAPE. The group developed several action items during a facilitated meeting, with the greatest priority to develop a strategy to document erosion and preserve cultural and scientific information archived in archaeological shell middens.

With ~2,000 middens on a lengthy and convoluted coastline and with financial resources for only two to three professional field investigations per year, volunteer participation were required if the effort was to develop data for large portions of the coast (Fig. 3).

Consequently, the MM program was created in conjunction with the MHPC to forge a link between academic/governmental research at shell middens and local citizens and tribal members to monitor and document the erosion of the numerous recorded but unstudied sites.

The MM program is based on three data-gathering approaches: 1) monthly midden "minding," 2) annual midden erosion survey, and 3) assessing storm damage.

MMs register through the program website (https://umaine.edu/middenminders/) and apply to monitor a site on a conservation association property/easement or a known site in their area. After completing hands-on training with a conservation organization or by reading website material, completing an online skills assessment, and providing evidence of permission of access to private property, volunteers collect data at midden sites. Website information includes an introduction to Maine shell midden archaeology and cultural sensitivities, data collection protocols, and safety precautions.

Information collected by Minders, in the form of notes and photographs, is recorded in an online database designed to protect site and landowner privacy and provide information for prioritization of sites for cultural resource management and archaeological research (*SI Appendix*, section S3 has details on the methodology associated with each data-gathering approach and associated database).

Bringing citizen scientists into a data collection program first required a shift in thinking for professional archaeologists in the state. In the past, the MHPC has only shared shell midden location information with landowners or trusted researchers in an effort to protect landowner privacy and discourage looting of middens to recover artifacts for personal collections or for sale. Recognizing that community residents already know where middens are located, the MM program is based on volunteer's local knowledge of eroding middens or participation of conservation organization members working on a group's properties or easements.

Unlike many other US citizen science sites, such as those that record phenology-related events, site location and erosion information will not be shared with the public. The database is accessible only to registered MMs and is designed so that individual contributors can see the record of efforts at sites that they choose to monitor but not the rest of the dataset. Administrators from the University of Maine, the MHPC, and participating conservation groups will also have access to the data, and researchers may apply for access. As data about individual site erosion are collected and archived, they can form the basis for informed cultural resource decisions. Information on erosion rates and destructive processes can help guide difficult prioritization assessments and focus limited recovery funding.

Academically trained archaeologists act as regional program representatives. These individuals are either active or retired professionals available to respond quickly and offer advice in the case of large-scale erosion events or exposure of significant artifacts.

Conservation groups, most notably the Coastal Rivers Conservation Trust (stewards of the Damariscotta Glidden Midden), are actively forming monitoring groups for their properties, and over 50 individuals from across Maine have expressed interest in participation. A training video and expansion of the website are in planning.

Ongoing funding is the greatest challenge facing this program. No nationwide or statewide cultural resource-monitoring program exists. The expense of setting up the program (initial meetings, website, database, and publicity) was provided by grant funding, but without provision for continuing expenses. Unlike the

[†]L. Clark, S. E. Miller, "Heritage monitoring scouts: Assessing citizen science programs utilizing outcome-based evaluation and self determination theory." Annual Conference for Association for Library Information Science Education, 25 September 2019, Knoxville, TN.

Fig. 3. Eroding face of the Glidden Midden in Newcastle, ME. This oyster shell midden is characteristic of the midcoast of Maine.

Florida programs, the MM is not run by an established program with dedicated staff and resources. However, with growing interest in both climate change impacts and cultural heritage, this challenge seems to be within reach.

Mitigating Loss

Projects such as SCHARP, HMS Florida, and Maine MM exemplify partnerships that collect data and monitor sites to better understand the heritage resource and threats it faces and inform prioritization. However, collecting data and recommending action as a high priority are meaningless unless these recommendations are put into action.

The NPS (6) outlined a series of possible actions that could help mitigate the loss of coastal heritage sites, including offsetting stress (where survival is enhanced with minimal changes to the site), improving resilience (although such work may impact the integrity of the resource), and relocating structures, such as moving the Cape Hatteras Lighthouse in North Carolina in 2000 in response to public outcry. The financial cost of attempting to preserve sites is a major consideration, and some action, such as the relocation of a monument, can be very expensive. While supporting the Cape Hatteras lighthouse move, Erlandson (25) wondered how many Native American sites were lost during the relocation project.

In Scotland, HES has a long history of working to protect some coastal sites from the sea, and early examples include coastal defenses built in St Andrews in the second half of the 19th century (44). These efforts have preserved monuments and enabled their development as major visitor attractions, bringing widespread economic benefits. However, so-called hard coastal defenses, such as rock armor and sea walls, are expensive to construct and maintain. Additionally, they deflect problems to other stretches of coast. In some places, local or national laws hinder coastal protection work—for example, Rhode Island, where permits are rarely granted for hard defenses or soft defenses (such as dune restoration or revegetation) because of cost and effectiveness (11).

Decisions that we make now will affect what we pass down to future generations. It may be appropriate to relocate some sites and physically protect others for a period of time, but many more will need to be managed in other ways. Berenfeld (45) argues that efforts to shore up an eroding site will eventually fail and that the money would be better spent on "creating a future history of that doomed place." With limited resources and time running out, we must develop creative approaches to deal with heritage loss. Although the physical site may erode and eventually be lost, preservation can be achieved in other ways: for example, by creating drawn or photographic records or compiling oral histories. Such work also opens further opportunities for public engagement, and Ives et al. (11) reported public desire to be involved in practical work at threatened places "while the sites still exist."

The second strand of SCAPE's Scotland's Coastal Heritage at Risk Project explored the creation of alternative futures for threatened heritage. Running alongside ShoreUPDATE surveys, communities were encouraged to propose project ideas that tackled management issues, provided interpretation, or addressed the need for further investigation at locally valued sites threatened by coastal erosion. These projects, known as ShoreDIGs, were collaborative at every stage. From site selection to deciding the recording technique and from practical work at the site to eventual curation of the product, new ways of working were created, and the heritage sites, in some form, were saved for future generations.

Fourteen ShoreDIG projects were undertaken, including conventional archaeological excavations, digital recording, three-dimensional (3D) model making, and relocating prehistoric structures for public display and interpretation (46). At Channerwick in Shetland, an eroding coastal section was cleaned, and the removal of fallen sand and slumped vegetation revealed a broch (a 2,000-year-old tower house of a design unique to Scotland). Most brochs are protected by law, and obtaining consent to excavate is usually difficult, but this eroded example was already sliced in half by the sea, allowing environmental and scientific dating samples to be taken of floor deposits, working surfaces, and layers that predated the broch's construction.

Similar community excavation work is being undertaken in the United States. Emergency rescue projects organized in Alaska (5) involve members of the local community and volunteers to save information from severely eroding sites, which suffer not only from coastal erosion but also, warming temperature leading to the degradation of organic material. On the barrier island of Pockoy, a major project coordinated by the South Carolina Department of Natural Resources is rescuing information from a rapidly eroding shell ring. In 2019, over 400 individuals volunteered on the project, recovering animal bones, tools, ceramic pottery, and shells that indicate Native American activity at this Late Archaic Period site more than 4,000 years ago (47).

However, such work can be fraught with complications in the United States. Terms like archaeological "salvage" or "rescue" are generally viewed positively in the United Kingdom and Europe, but this is not necessarily true for many indigenous people (11) who may see these efforts as "colonial archaeology." Excavation is not the only way forward, and alternative ways of recording sites can be applied to eroding sites where digging may prove difficult or unwelcome. In Stranraer, southwest Scotland, young ShoreDIG volunteers created films about an eroding World War II flying boat base by integrating interviews with older community members with contemporary footage, thus taking the stories of the base from the past into the future. This video documentary approach accords with the NPS sentiment that "every place has a climate story" (48), something that was explored more fully during the Learning from Loss program (ref. 49 has examples of climate stories).

Digital survey also presents opportunities, and an ambitious community project from Scotland's east coast saw the Save

Wemyss Ancient Caves Society working with professional archaeologists to record Pictish carvings dating to AD first millennium (50). The caves, coastline, and carvings were documented using laser scanning, photogrammetry, and reflectance transformation imaging (51). The data were used to build an interactive 3D resource that allows online visitors from around the world to explore the caves and surrounding coastal setting, closely examine the carvings, and access historic documentation (52).

Discussion

The examples above highlight the similarities in ambition and approach on both sides of the Atlantic, where the value of including the public in recording and taking action at vulnerable coastal heritage sites is becoming increasingly important in a time of accelerating heritage loss. Partnership building is a key element when managing risks associated with climate change (15), and working with a range of stakeholders allows the integration of resources (18) and the involvement of members of local communities (53). However, it is also worth reviewing the challenges of adopting a citizen science approach.

The first is access; "right to roam" laws in Scotland mean that it is easier to visit coastal sites as the public has greater freedom to explore the coast and countryside than in many other places. A second constraint is the issue of making location data accessible. There are legal constraints (Section 304 of the National Historic Preservation Act and Section 9[a] of the Archaeological Resources Protection Act) and genuine worries about making location data public in the United States due to the potential desecration of Native American sites, fear of looting, privacy concerns, and land ownership matters. These constraints do not exist to the same extent in the United Kingdom, where location information of historic assets is already widely available through online national heritage databases (https://pastmap.org.uk/). The US projects discussed above are overcoming site location issues by making a data subset available to trusted (and vetted) volunteers. This is a good start, but making a subset of data more widely available, for example, by publishing it on the internet for all to see might increase the chance of the publicized sites being looted. Conversely, it could be argued that recruiting citizens to monitor sites and building a culture of stewardship reduce such risks. In the light of the eventual destruction of some sites, it may be worth risking some threatened sites in order to save others. This is a complex issue for heritage managers, and it is likely that, as greater numbers of sites are destroyed due to climate change, the arguments for and against making data available will become more prominent.

Resourcing is another constant challenge, and funding for cultural heritage management is limited and often short term. One lesson learned over 20 years of community work in Scotland is that continuity is extremely valuable. Volunteering works best when it is purposeful and when the information collected is valued and used. Community groups and individuals need someone to report to and appreciate feedback, and collecting records that are not moderated or acted on soon leads to volunteers losing interest in a project.

Erlandson (25) speculated that past inaction on heritage threatened by climate change may partly be due to the problem being too large, especially for agencies already hard pushed to cope with existing workloads. In each of the examples above, a process of survey and prioritization has been applied to make action more manageable, with university-based staff working with communities and heritage agencies to implement solutions at a local level. However, long-term project sustainability remains a challenge. Although university-based research allows freedom to develop new approaches and protects researchers from organizational shifts of focus, it can present challenges in sustaining long-term funding.

The examples above and many more around the world show what can be achieved in the face of a significant and developing heritage crisis. Heritage professionals and communities are working together to produce effective responses to the loss of coastal heritage. Action is being taken, and the projects have provided a body of work that demonstrates a range of positive responses. These successful projects address threatened coastal heritage through a local lens, and eroding heritage is deployed as a resource that gives agency to individuals and communities by breaking down a seemingly insurmountable problem into smaller, manageable windows of opportunity.

Citizen science projects help to make heritage management relevant to a wider part of the population, connecting more people to the impacts of climate change and coastal processes. They gather meaningful data used to make informed decisions now that will affect subsequent generations. An open decision-making process helps deflect criticism. If sites are to be abandoned to their fate, involving a greater number of partners in the process allows a wider range of views to be explored, resulting in greater confidence that decisions will be supported. Additionally, such approaches present opportunities to discuss climate change and heritage loss, providing communities with the tools to address impacts that will become more common in the future. The examples above show how we can respond to heritage loss in the face of climate change. We hope to see many similar approaches in the coming decades.

There are no data associated with this manuscript.

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