

# Maritime Archaeological Research, Sustainability, and Climate Resilience

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*Maritime archaeology has been identified as a significant field among the humanities that could contribute to the global sustainable development agenda. This article explores the relevance of maritime archaeological studies to initiatives of climate action. By reviewing the contributions of various state-of-the-art projects and by linking their aims and outcomes to specific targets of the UN Sustainable Development Goals, the author highlights the benefits of involving maritime archaeological research in the pursuit of sustainability and climate resilience. This involvement could play a key role in reinforcing human-centred and culturally aware solutions to the current climate change effects that threaten human populations, especially in maritime regions. It is hoped that this discussion will inspire researchers in the humanities, archaeology, and maritime archaeology in particular, to use their expertise within the framework provided by the sustainable development agenda to help build a better future.*

**Keywords:** maritime archaeology, cultural heritage, climate emergency, sustainability, climate resilience

## INTRODUCTION

Human activities have always influenced the environment and human societies have always been affected by nature and other environmental changes that occurred on Earth. Anthropologists, archaeologists, historical ecologists, social geographers, and other scientists have examined these interactions between humans and the natural environment in different regions and eras of the human past; recent studies include Redman (2005), Rick and Erlandson (2008), Van de Noort (2013), Erlandson and Braje (2013), and Crumley (2021).

The current, human-induced, climate emergency faced by society has brought to the foreground the study and understanding of human actions in relation to the

natural environment. Maritime archaeology, a discipline that examines material culture related to human interactions with the sea and other aquatic environments (McKinnon, 2014), has been identified as a significant field among the humanities that could contribute to the pursuit of environmental sustainability and climate resilience (Henderson, 2019; Lee, 2019; Trakadas et al., 2019; Rey da Silva, 2020).

In this article, I discuss the various ways that maritime archaeological research could be used within the realities of the climate emergency. Following a brief outline of the aims and methodology of this study and an overview of current human–environment interconnections within the climate crisis, the discussion moves on to cultural heritage and archaeology as integral parts of climate

action, and the various contributions of maritime archaeological research to the global response to climate change. The relationship between maritime archaeological studies and climate action initiatives, and the applicability of the discipline in pursuing sustainability and climate resilience, is illustrated through a review of various maritime archaeological research projects. The interconnection of these initiatives to the UN Sustainable Development Goals (SDGs) is explained in the hope to encourage researchers to play a more active role in climate action.

### AIMS AND METHODOLOGY

My aim is to highlight the interdisciplinary perspectives of maritime archaeological research and its relevance to the global challenges humanity is currently facing. While the significance of maritime archaeology and maritime heritage in climate action initiatives has been discussed before (e.g. Henderson, 2019; Trakadas et al., 2019; Rey da Silva, 2020), here I attempt to move a step further. By reviewing and analysing the contributions of various state-of-the-art projects and by linking their approach to specific targets of the UN SDGs, I hope to show the necessity of involving maritime archaeological research in the pursuit of sustainability and climate resilience. This involvement could play a key role in reinforcing human-centred and culturally aware solutions for the current climate change effects that threaten maritime populations.

To collect the data, a systematic literature search was conducted through online library databases of the University of Southampton and the University of Helsinki as well as Google Scholar, using the keywords ‘climate change’, ‘archaeology’, and ‘cultural heritage’. Given the maritime focus of this paper, the search

concentrated on projects dealing with maritime areas, coastal or underwater archaeological remains, and maritime heritage assets (tangible and intangible).

Altogether, this study brings together concrete examples that show the suitability of maritime archaeological research perspectives in climate action, sustainable development, and climate resilience initiatives. I hope that this discussion will inform but also inspire researchers to become actively involved with the implementation of the SDGs by offering their unique academic expertise to help build a better future.

### PRESENT-DAY HUMAN-ENVIRONMENT INTERACTIONS AND THE CLIMATE EMERGENCY

Since the second half of the twentieth century there has been increasing evidence that human activities have been influencing the Earth systems more than usual (Erlandson & Braje, 2013: 1–3; Van de Noort, 2013: 6–10; Crumley, 2021). For decades, changes in the Earth’s climate have been recorded in every region of the planet and across the whole climate system (IPCC, 2019). Today it is a scientific fact that human actions have warmed the atmosphere, oceans, and land, causing widespread and rapid change across the planet. However, as the latest reports on climate change by the Intergovernmental Panel on Climate Change (IPCC, 2021, 2022) have pointed out, human actions can still determine the future course of the climate. Immediate action involving rapid and large-scale reductions in greenhouse gas emissions could limit the Earth’s warming, which potentially would allow the planet to recover (Van de Noort, 2013: 10; Rockman & Hritz, 2020: 8295).

The steps necessary to fight climate change and build a resilient future are

clearly expressed in the seventeen Sustainable Development Goals of the United Nations (UN SDG, n.d), adopted by all United Nations Member States in 2015. The goals are to promote peace and prosperity for people and the planet, now and into the future, to end poverty and other deprivations, improve health and education, reduce inequality, and stimulate economic growth—all while tackling climate change and working to preserve our oceans and forests.

### CULTURAL HERITAGE AND ARCHAEOLOGY AS INTEGRAL PARTS OF CLIMATE ACTION

The SDGs target both humans and the natural environment. The successful implementation of this plan requires an effort that involves active engagement and a change of attitudes and behaviours by policymakers, stakeholders, societies, social groups, and individuals. Involving cultural heritage in these efforts is considered important, especially because culture is seen as vital to understanding climate change vulnerability (Thomas et al., 2019).

Riede and Krogh (2019) have pointed out various benefits of involving cultural heritage in climate action. Indeed, cultural heritage, both tangible and intangible (ICOMOS, 2019: 2), can assist in the implementation of adaptation strategies since it can define identities, build social capital, and build a sense of togetherness. Managing cultural heritage will involve plans to preserve materials potentially threatened by climate change, and an understanding of the past can also highlight past solutions and responses to similar events. Scholars (e.g. Flexner, 2020; Zorzini, 2021) have also discussed the prospects of archaeology within the degrowth movement. By moving away from the destructive (for the planet and society) capitalist model, archaeology has the potential as a discipline to become a sustainable activity

that pursues knowledge for the benefit of society, and can, therefore, shape the future within ongoing socio-ecological crises. So, cultural heritage, archaeological knowledge, and practice, if exercised and used appropriately, could drive and enable sustainable development, as posited by Rey da Silva (2020: 109), for a better future.

The International Council on Monuments and Sites' report (*The Future of our Pasts*, ICOMOS, 2019) sets out how the global heritage community can work towards building resilience and meeting the goals of the Paris Agreement, a legally binding international treaty on climate change that entered into force in 2016. In that report, it was noted that cultural heritage could help in adaptation and mitigation strategies, while also preserving people's identities, history, and cultural practices for the future. The close connections between Culture and Nature in most landscapes and seascapes also form the subject of more recent ICOMOS reports (De Marco et al., 2020; ICOMOS, 2021).

The Climate Heritage Network released a manifesto on 'Accelerating Climate Action through the Power of Arts, Culture and Heritage' as part of the UN Climate Conference held in Glasgow in 2021. This manifesto states 'that people, their cultures, and the natural and cultural heritage of the earth are profoundly at risk from human-caused climate change and the climate inaction that is deepening the unfolding climate crisis' and 'reaffirm[s] the immense power of [the] arts, culture, and heritage to inspire climate action and enable a just transition to low carbon, climate resilient futures' (Climate Heritage Network, 2021).

Despite the close relevance of cultural heritage to climate action, archaeologists are among those whose talents have not yet been substantially mobilized on climate change issues (Rick & Erlandson, 2008: ix–x; Wright, 2016: 255–56; Rockman &

Hritz, 2020: 8295). Like historical ecology, which has been analysed extensively by Crumley (1994, 2018, 2021), archaeology has much to offer in the pursuit of the sustainability and climate resilience of present-day and future human societies (Redman, 2005: 70–71; Isendahl & Stump, 2019). Van de Noort (2011) conceptualized the idea of a ‘climate change archaeology’ that interconnects people and communities entirely within the landscape they inhabit and recognizes that climate change has a direct impact on humans, leading indirectly to adaptations within societies to climate and environmental change. This concept has highlighted the potential benefits of archaeological research to modern climate change debates. The important contribution of archaeology in tackling the climate emergency has also been highlighted by Fluck (2022) in her ‘Letter to a young archaeologist’, in which she explains that ‘as an archaeologist you won’t be rich, you are unlikely to be famous, but you can help to save the planet’. In her words, archaeologists have ‘superpowers’, including ‘storytelling, time travel, evidence of how people change the environment, and evidence of how people can live without fossil fuels’ (Fluck, 2022).

Archaeology is a discipline that, in its study of the human past, tracks interactions between natural and social environments through time and across space. Hence it can provide significant assets for dealing with the climate crisis (EAA, 2021). Archaeological research can provide information about past human environments and the impact of humans on the Earth’s landscapes and ecosystems (Van de Noort, 2011, 2013; Erlandson & Braje, 2013: 3; Wright, 2016: 256; Fitzpatrick & Erlandson, 2018: 286–94; Harkin et al., 2020: 621; Rockman & Hritz, 2020: 8296–97). It can also offer information on how past societies behaved in times of

environmental crisis and climate change (Redman, 2005: 71; Kowarik et al., 2022). Furthermore, archaeologists could help expand the capacity of our global climate response by addressing the complexity of the current human social environment (Rockman & Hritz, 2020: 8295–97). Balancing the physical realities of the natural environment with the complexity of the human social environment, including their histories, cultures, attitudes, and values, is an issue that should be addressed if humanity is to achieve climate resilience. Hence, as Redman (2005: 71–72) argues, archaeologists would be important players in multidisciplinary teams working on sustainability planning since they understand how human societies work and act, especially in circumstances of crisis (Hegmon, 2017). Finally, Rockman and Hritz (2020: 8295–96) observe that archaeology is involved in cultural heritage and cultural resources management, which regularly engages with values such as site significance and allocation of funding that the modern social environment ascribes to its own history. The urgency for archaeologists to act on climate change are also expressed by Fluck and Guest (2022), who recommend a ‘climate-first approach’ in archaeological and heritage projects. This prioritizes the reduction of greenhouse gas emissions, promoting ways of helping people and the environment adapt to the changing climate and mitigate the impact of climate change on heritage assets. Archaeology and heritage can play decisive parts within this agenda.

#### THE CONTRIBUTIONS OF MARITIME ARCHAEOLOGY TO SUSTAINABILITY AND CLIMATE RESILIENCE

Maritime archaeology is the scientific recording, study, and interpretation of the past through the material culture and remains of human activities located in and

around aquatic environments including seas, oceans, lakes, and rivers (Muckelroy, 1978; Adams, 2002; Bass, 2011; Westerdahl, 2011: 754; Ford et al., 2020). It can contribute substantially to current climate action initiatives, especially given its multi-disciplinary nature and human-scale approach (Flatman, 2012; Wright, 2016; Rey da Silva, 2020: 110; Varmer et al., 2020).

Although the relevance of maritime archaeology to sustainable development has not been explicitly stated in any international agreements, the significance of the discipline in handling the climate emergency has been emphasized by the recognition of the oceans' cultural heritage and ocean literacy programmes as integral parts of the 2021–2030 UN Decade of Ocean Science for Sustainable Development (Lee, 2019: 137–46; Rey da Silva, 2020: 108–10, 113; Varmer et al., 2020: 9–11). In the setting of the Ocean Decade (2021–2030) that focuses mainly on SDG 14 (Life below Water), ocean cultural heritage, or marine cultural heritage and maritime cultural heritage, is conceived as representing all kinds of human interactions with the oceans and seas. This includes both tangible cultural heritage remains, such as shipwrecks, submerged sites, coastal archaeology, ports, and harbours, and intangible elements, such as cultural practices, artistic and linguistic expressions, local skills, or traditional and historical knowledge, all of which are subjects of maritime archaeological research (Henderson, 2019; Lee, 2019: 138, 142–43; Trakadas et al., 2019: 153–57; Rey da Silva, 2020: 110; Trakadas, 2021). The Ocean Decade Heritage Network (ODHN, <<https://www.oceandecadeheritage.org>>), initiated in 2019, acknowledges the relevance of maritime archaeology to the implementation of the Ocean Decade (UN Decade of Ocean Science for Sustainable Development, 2021–2030; Trakadas, 2022a, 2022b).

To reach a better understanding of the interconnection between maritime archaeology and sustainability it is useful to present the contributions of this discipline through interdisciplinary research examples that have the capacity to address specific UN SDGs (Table 1) and thus inform on sustainable development, climate adaptation, and climate resilience.

### **Examples from past human–environment interactions**

Given that maritime archaeology examines aspects of human interactions with aquatic environments over time and space, it can provide rich datasets and deep knowledge of the human–environmental past with examples of palaeoclimatological or paleo-environmental data as well as cases of human risk, adaptation, and resilience (Van de Noort, 2011: 1040–41; Wright, 2016: 264; Trakadas et al., 2019: 159; Dawson et al., 2020: 8280–81; Rey da Silva, 2020: 114; Hillis et al., 2022). Historic examples of human coastal occupation, environmental change, and human impacts are illustrated in eleven case studies from the Americas, the Pacific Islands, Europe, and Africa in a collection edited by Rick and Erlandson (2008). Similarly, Van de Noort's (2011, 2013) research on the North Sea, as well as the Sundarbans in the Bay of Bengal, the wetlands of Florida's Gulf coast, and the Iraqi marshlands are further examples of past adaptation to the environmental impacts of climate change.

More recently, targeted research projects, such as Meyer's (2020) analysis on cultural heritage in the Netherlands, have shown how adaptation and mitigation strategies regarding natural water-related threats existed for several centuries. Ilves' (2022) ongoing project 'Survivors of Ragnarök' also discusses human responses

**Table 1.** Examples of contributions of maritime archaeological research to associated SDGs and targets of the UN Sustainable Development agenda. Texts of the SDGs are based on information made available by the UN Department of Global Communications here: <https://www.un.org/sustainabledevelopment/news/communications-material/>.

| Contributions of maritime archaeological research                                       | Associated SDGs  |
|---|--|
| <i>Examples from past human–environment interactions</i>                                | <p><b>SDG 13 ‘Climate Action’</b><br/> <b>13.1:</b> Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.</p>   |
| <i>Understanding aquatic environments and their impact on material culture</i>          | <p><b>SDG 14 ‘Life Below Water’</b></p> <p><b>SDG 11 ‘Sustainable Cities and Communities’</b><br/> <b>11.5:</b> By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.<br/> <b>11.b:</b> By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015–2030, holistic disaster risk management at all levels.</p>  |
| <i>Protecting and safeguarding cultural heritage assets from climate change effects</i> | <p><b>SDG 13 ‘Climate Action’</b></p> <p><b>SDG 11 ‘Sustainable Cities and Communities’</b><br/> <b>11.4:</b> Strengthen efforts to protect and safeguard the world’s cultural and natural heritage.</p>   |
| <i>Use of local, indigenous, and traditional knowledge</i>                              | <p><b>SDG 7 ‘Affordable and Clean Energy’</b><br/> <b>7.a:</b> By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency, and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology.</p>   |
|   | <p><b>SDG 8 ‘Decent Work and Economic Growth’</b><br/> <b>8.9:</b> By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products.</p>  |
|   | <p><b>SDG 11 ‘Sustainable Cities and Communities’</b><br/> <b>11.4:</b> Strengthen efforts to protect and safeguard the world’s cultural and natural heritage.<br/> <b>11.5:</b> By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.<br/> <b>11.b:</b> By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015–2030, holistic disaster risk management at all levels.</p> |



Table 1. (Cont.)

| Contributions of maritime archaeological research  | Associated SDGs   |
|--|---|
| <i>Initiating climate awareness and global cooperation for climate action and adaptation</i> | <p><b>SDG 12 ‘Responsible Consumption and Production’</b><br/> <b>12.2:</b> By 2030, achieve the sustainable management and efficient use of natural resources.</p> <p><b>12.b:</b> Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products.</p>   |
|  | <p><b>SDG 14 ‘Life Below Water’</b><br/> <b>14.2:</b> By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans.</p> <p><b>14.4:</b> By 2020, effectively regulate harvesting and end overfishing, illegal, unreported, and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics.</p> <p><b>14.5:</b> By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information.</p> |
|  | <p><b>14.7:</b> By 2030, increase the economic benefits to Small Island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture, and tourism.</p>  |
|  | <p><b>14.b:</b> Provide access for small-scale artisanal fishers to marine resources and markets.</p>   |
|  | <p><b>SDG 4 ‘Quality Education’</b><br/> <b>4.7:</b> By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship, and appreciation of cultural diversity and of culture’s contribution to sustainable development.</p>   |
|  | <p><b>SDG 12 ‘Responsible Consumption and Production’</b><br/> <b>12.8:</b> By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature.</p>   |
|  | <p><b>SDG 13 ‘Climate Action’</b><br/> <b>13.3:</b> Take urgent action to combat climate change and its impacts.</p>  |
|  | <p><b>SDG 15 ‘Life on Land’</b><br/> <b>15.9:</b> By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts.</p>  |
|  | <p><b>SDG 17 ‘Partnerships for the Goals’</b><br/> <b>17.9:</b> Enhance international support for implementing effective and targeted capacity-building in developing countries to support national plans to implement all the Sustainable Development Goals, including through North–South, South–South, and triangular cooperation.</p>   |

to major environmental shifts by the resilient communities of the Åland Islands in Finland that can serve as concrete examples of human adaptability in the face of cataclysmic challenges. The CITiZAN's (2021) projects in the UK illustrate how humans have been adapting to changes in climate for thousands of years, while CHERISH (n.d.), an innovative cross-disciplinary project, aims at increasing knowledge on the impacts (past, present, and near-future) of climate change, storms, and extreme weather events on the cultural heritage of reefs, islands, and headlands of the Welsh and Irish seas (Robson, 2021).

These examples illustrate that understanding and recording archaeological data and past adaptation strategies offer insights into methods of protecting coastal towns and landscapes (Hutchinson et al., 2021; Preshlenov, 2022). Indeed, 'the lessons from the past should be about the pathways followed by communities in their adaptation to climate change, and the positive and negative feedbacks that ensued' (Van de Noort, 2011: 1041). Moreover, this research illustrates that the 'new' policies required for dealing with the current problems of climate change are not necessarily novel or threatening to traditional ways of living; on the contrary, they have a long historical basis for humanity.

Knowledge about the human-environmental past can contribute directly to SDG 13 (Climate Action) since the relevant datasets can help improve education and awareness related to climate change, while also developing human and institutional capacity to build resilience, proceeding with climate change mitigation and adaptation, and reducing the impact of climate-related hazards and natural disasters (SDG target 13.1). Additionally, evidence from maritime archaeology can inform generally on the sustainable management and protection of marine and coastal ecosystems and on actions for their

restoration (SDG 14) since, as Henderson (2019) notes, 'the current marine biodiversity and the ecological composition of coastal environments are the result of sustained human action over millennia'.

### Understanding aquatic environments and their impact on material culture

Archaeological knowledge of coastal and submerged sites and environments, of site formation processes and site preservation can contribute to the planning, protection, and mitigation strategies for land areas expected to face extreme flooding or submersion due to the expected sea-level rise (Perez-Alvaro, 2016: 844–48; Hein, 2020; Ricca et al., 2020). Already, coastal sites, those underwater, and generally those close to aquatic environments are highly affected (Hamdan et al., 2021; Sesana et al., 2021: tab. 1). The work conducted by Ezcurra and Rivera-Collazo (2018) on the impact of general sea-level rise and specifically hurricane Maria on Puerto Rico's coastal archaeological remains and cultural heritage assets highlight the importance of these assessments (Rivera-Collazo, 2020). The ability to evaluate and measure an archaeological site's vulnerability and sensitivity are significant assets that could help us better understand social and community vulnerability to climate change, and hence assist in safeguarding human populations and material culture (Thomas et al., 2019; Dawson et al., 2020: 8280–81).

A project that explores the coastal sites vulnerability is SCAPE (n.d.). It researches where and how Scotland's heritage is being affected by natural coastal processes and how climate change may affect this in the future. Similar work has been undertaken in Wales and Ireland (CHERISH, n.d.; McCormick & Nicolas, 2022), in Florida by the Florida Public Archaeology Network, in Maine by the Midden Minds (Dawson et al., 2020:



8282–84), and in Cartagena de Indias, Colombia (Báez Santos & Riera, 2022). Such research enables gaining information on wider coastal environmental change and climatic events, which can help devise mitigation strategies and prioritize actions at the most vulnerable sites (Hambly, 2017; Dawson et al., 2020: 8284–85).

Understanding aquatic environments and their impact on material culture can assist with SDG 13 but also SDG 11 (Sustainable Cities and Communities) by providing data for disaster risk assessments that could substantially help cities and human settlements to adapt to climate change and build resilience to water-related disasters (SDG 11.5 and 11.b).

### **Protecting and safeguarding cultural heritage assets from climate change effects**

The projections of climate change effects, including global warming, sea-level rise, droughts, and other extreme weather and environmental events, pose a threat to coastal, underwater, and inland heritage sites and assets which might be affected by the changing nature of aquatic environments in their surroundings (Croft, 2013; Dawson et al., 2020: 8281; Harkin et al., 2020: 621; Rey da Silva, 2020: 110; Ricca et al., 2020; McCormick & Nicolas, 2022; Vousdoukas et al., 2022). The ICOMOS report (2019, *The Future of our Pasts*) highlights the potential threats of climate change on cultural heritage worldwide. These threats have also been identified in SDG 11 (Sustainable Cities and Communities), with target 11.4 recommending to ‘strengthen efforts to protect and safeguard the world’s cultural and natural heritage’ (Trakadas et al., 2019: 159; Varmer et al., 2020: 10–11). Clearly, now and in the near future, adaptation and mitigation strategies will be needed

for cultural heritage management stakeholders (Fluck, 2016; Wright, 2016: 256–57; Harkin et al., 2020: 622, 629–31; EAA, 2021; Kountouri et al., 2022).

Several projects have pointed out that climate change already has an impact on submerged and coastal archaeological sites. Harkin et al. (2020: 624–29) describe several factors that affect coastal heritage, including sea-temperature change with consequent changes in the ecosystems, erosion processes, sea-level rise, and ocean acidification. Perez-Alvaro (2016) discusses four main climate-related changes that are expected to affect tangible underwater cultural heritage assets, while Sesana et al. (2021) note that water is a main agent of material degradation of outdoor sites, at least in Europe. Additionally, changes in the properties of the oceans, flooding, sea-level rise, storm surges, coastal erosion, coastal flooding and inundation, material erosion caused by wind and wind-driven rain, as well as permafrost thawing have serious implications for tangible maritime cultural heritage assets and sites (Sesana et al., 2021: tab. 1). As mentioned previously, Van de Noort (2013: 10–17) has extensively analysed the impact of climate change on coastal wetlands, and Wright (2016: 257–63) has described how seagrass acts as an important anchor for submerged sites, preventing artefact exposure, as well as encouraging protective and anaerobic sediment coverage. Seagrass retreat or decline due to sea-level rise and increase of depths of submerged sites could thus result in increased erosion, alteration of site sediment dynamics, and the possible loss of artefacts and site stability. Most recently, Vousdoukas et al. (2022) created a database of 213 natural and 71 cultural African heritage sites and assessed their exposure to coastal flooding and erosion under moderate (Representative Concentration Pathway or RCP 4.5) and high (RCP 8.5) greenhouse

gas emission scenarios. This research showed that, due to the growing risk of climate change events, there is an urgent need for increased climate change adaptation for heritage sites in Africa, including governance and management approaches, site-specific vulnerability assessments, exposure monitoring, and protection strategies.

The examples cited make it amply clear that the role of maritime archaeologists in identifying risks, as well as managing, protecting, and preserving cultural heritage assets along with the natural environment in maritime and inland sites, as described in the SDG target 11.4, is vital at this time of climate emergency.

### **Use of local, indigenous, and traditional knowledge**

Maritime archaeological research has benefitted from local, indigenous, and traditional knowledge regarding maritime spaces through maritime ethnography (McGrail, 1984). Currently, local, indigenous, and traditional knowledges in relation to the natural environment are considered a significant asset in climate action (Rockman & Hritz, 2020: 8296–97; Andersson et al., 2021; Casi et al., 2021; FAO & FILAC, 2021; Ibrahim, 2021; Peuramaki-Brown & Morton, 2021); especially communities, who live in the proximity of oceans, rivers, and lakes, have known, observed, and lived with dynamic natural environments for centuries, so they have developed ways of building resilience, mitigating their activities, and improving their livelihoods as well as helping the natural environment to recover (Lauer & Aswani, 2009; Henderson, 2019; Neal, 2020; Rey da Silva, 2020: 123–25). The recording, understanding, and protection of this knowledge could significantly benefit academia and policy-makers and therefore contribute to

present-day attempts at adapting to the changing climate by balancing past experiences with new ways of coping (IPCC, 2019, 2022). These efforts are particularly important for maritime regions, given the vulnerability of local and indigenous communities living in coastal areas and islands directly threatened by climate change impacts and related hazards (Hiwasaki et al., 2015: 36–37).

The project ‘Re-imagining the Use of Traditional Watercraft in the Aegean Sea for a Sustainable Environment and Economy’ (hereafter ‘Re-imagining Traditional Watercraft’) recognizes local, indigenous, and traditional knowledge and its associated tangible and intangible maritime cultural heritage as potential drivers of sustainability and climate resilience. The Aegean Sea, as many other maritime regions, saw the loss of non-polluting traditional watercraft made of wood and propelled by sails or rowing from the nineteenth century onwards (Antoniu, 1969; Gillmer, 1973; Damianidis & Zivas, 1986), coinciding with a transition to metal or fibreglass motorboats and the introduction of large-scale fishing trawlers and transport ships. This shift led to the loss of traditional maritime jobs, the development of solely touristic economies, and the destruction of the marine environment from the extensive use of large-scale polluting fisheries, cargo, and passenger ships (Miliou et al., 2018; Delis, 2020). Currently, in the face of the climate emergency, the significance of small-scale traditional watercraft, as well as the revival of traditional commercial sea-routes among the Aegean islands, have been brought back to the fore to improve the natural environment; they provide low-carbon, energy-efficient transport and promote more sustainable economies in the region (Rassia & Tsikis, 2020; Aegean Cargo Sailing, n.d).

In ‘Re-imagining Traditional Watercraft’, the recording of local and traditional knowledge related to traditional boats, as well as

the research on the response and adaptability of the local populations through archaeological and ethnographic perspectives, has produced results that can contribute to several SDGs. For example, by documenting historically and archaeologically the shift from wooden non-fuel boats to polluting steam and motorboats, it is possible to protect and safeguard the remaining traditional watercraft as described in SDG target 11.4. Initiatives like the new Museum of Aegean Boatbuilding and Maritime Crafts, to be inaugurated at the island of Samos in 2023, can strengthen the maritime identities of local coastal and island communities. At another level, data from the study of the socio-political circumstances that led to the disappearance of traditional non-polluting boats and the impact on the local economies, communities, and marine environment, can be used for sustainable solutions that protect marine ecosystems (SDG targets 14.2 and 14.5) and maritime communities (SDG targets 11.5 and 11.b). Finally, by gauging the reaction of locals to the re-introduction of traditional boats, and promotion of small-scale local economies that preserve the marine environment, it is possible to suggest effective compromises that bridge the gap between modern scientific knowledge and traditional maritime knowledge. This can inform on optimal ways of developing sustainable fishing and maritime transport strategies and managing marine and coastal resources effectively (SDG target 12.2) while providing low-carbon energy-efficient solutions (SDG target 7.a) and improving local people's livelihoods. Therefore, this data can support small-scale enterprises and producers (SDG targets 14.4 and 14.b) and promote the development of sustainable tourism (SDG targets 8.9, 12.b, and 14.7).

Comparable conclusions that highlight the importance of local knowledge for the sustainable development of maritime people have been brought to light by case studies in East Africa (Holly et al., 2022)

and from the project 'Indigenous People, Traditional Ecological Knowledge, and Climate Change: The Iconic Underwater Cultural Heritage of Stone Tidal Weirs' (UN Decade of Ocean Science for Sustainable Development, 2022). The 'Rising from the Depths' (2017) initiative in East Africa provides evidence on how the preservation of maritime cultural heritage and traditional knowledge of coastal communities can assist in building future resilience and adaptation plans for vulnerable maritime populations. The 'Iconic Underwater Cultural Heritage of Stone Tidal Weirs', by examining the archaeological remains of weirs as a sustainable, eco-friendly fishing practice based on traditional ecological knowledge that has provided balance and harmony for indigenous people for thousands of years, demonstrates that understanding these maritime heritage assets and the associated intangible elements can help future sustainable marine ecological conservation.

### **Initiating climate awareness and global cooperation for climate action and adaptation**

The projects described have shown that initiatives involving maritime archaeology have the power to engage with the public and create awareness on both the cultural and natural heritage (Wright, 2016: 266–67; Thomas et al., 2019; Dawson et al., 2020; Trakadas, 2022a). As Neal (2020) remarks, 'heritage sites can serve as opportunities for climate communication and education, and research on historic sites and practices to understand past responses to changing climate conditions can help adaptation and mitigation planners develop strategies that integrate natural science and cultural heritage'. CITiZAN's (2021) researchers have noted that sharing local climate stories opens up a much-

needed discussion about climate change and climate action. These observations make it clear that maritime archaeological research can promote SDG targets 4.7, 12.8, and 13.3 by sharing with the public relevant information and awareness regarding climate change, sustainable development, and lifestyles in harmony with nature. The interdisciplinary projects ‘Coastal Communities Adapting Together’ (CCAT, n.d.) and LIVE (n.d.) in Wales and Ireland have aimed to promote climate awareness within local coastal communities, while helping them to adapt to ways that would preserve their natural and cultural heritage.

Maritime archaeological projects could also help integrate ecosystem and cultural heritage values in national and local planning (SDG target 15.9), for example in maritime spatial planning (Kyvelou et al., 2022). The work conducted at Cartagena, Colombia, has highlighted the necessity of climate change protection mechanisms at a local level to integrate communities, institutions, and academia in a way that successfully safeguards maritime cultural heritage and the identities of the local people (Báez Santos & Riera, 2022). Holly et al. (2022) have also explained how incorporating the protection of marine cultural heritage into local and regional environmental frameworks, and specifically into marine policy and management efforts, can help with monitoring the change of dynamics in natural habitats, the cumulative impacts of climate change, and the development of social adaptation strategies.

Finally, the interdisciplinary nature of maritime archaeology and the international and multinational networks that exist can promote global partnerships for sustainable development by assisting in capacity-building, knowledge, and expertise sharing for the implementation of the UN SDGs at a global scale (SDG target 17.9). Such

collaboration to preserve the past and build capacity to navigate a challenging future has been carried out successfully in East Africa (Rising from the Depths, 2017; Holly et al., 2022) as well as with the PERICLES project (Delaney, 2020; Kenter & Martino, 2021) in Europe. The exciting results from these projects should encourage more global initiatives with a clear focus on the implementation of sustainability and climate resilience goals that can safeguard the local populations along with their cultural heritage and the natural environment.

## CONCLUSION

Maritime archaeology with its interdisciplinary perspectives, methodologies, and research topics can be a climate action asset, as well as a driver of sustainability and climate resilience. In this article, I have presented examples from the human–environmental past, giving insights into the impact of aquatic environments on material culture, and instances of recording, assessing, and safeguarding cultural heritage assets; I have also highlighted the importance of local and traditional knowledge and the ability to come in contact with the general public and initiate climate awareness while also promoting global cooperation. As several active projects have shown, maritime archaeological research could provide place-based and human-centred solutions. Encouraging the involvement of maritime archaeologists in climate action and creating the space for the development of interdisciplinary and transdisciplinary projects that use their talents could assist in the implementation of the sustainable development goals, the materialization of adaptation, and mitigation strategies.

Given the urgency of the current climate crisis, the maritime archaeological

community, like many others, has the scope, role, and potential to provide much-needed aid in shaping a safe, inclusive, and sustainable future. Training, funding, and collaboration opportunities could integrate maritime archaeological research more fully in the pursuit of sustainability and climate resilience. This can give policymakers, local and regional stakeholders, and the wider public the tools to integrate the natural and cultural heritage within social contexts that have a past, a present, and a future.

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## Archéologie maritime, développement durable et résilience climatique

*L'archéologie maritime a été reconnue comme un domaine important des sciences humaines capable de contribuer au programme mondial de développement durable. Cet article concerne la pertinence des recherches en archéologie maritime par rapport aux initiatives de lutte contre les changements climatiques. Un examen des intentions et résultats de projets récents et de leurs liens avec les objectifs de développement durable des Nations Unies met en relief les avantages qu'une participation de l'archéologie maritime offre pour atteindre ces objectifs de durabilité et de résilience climatique. Cet engagement pourrait jouer un rôle décisif car, en mettant l'accent sur les dimensions humaines et culturelles, on pourrait trouver des solutions aux problèmes posés par les effets du dérèglement climatique menaçant l'humanité, en particulier dans les zones maritimes. L'auteur espère que cet article encouragera les chercheurs en sciences humaines, en archéologies et tout particulièrement en archéologie maritime de mettre leur expertise au profit d'un monde meilleur dans le cadre des objectifs de développement durable.*

Translation by Madeleine Hummler

*Mots-clés:* archéologie maritime, patrimoine culturel, urgence climatique, développement durable, résilience climatique

## **Maritime Archäologie, Nachhaltigkeit und Klimaanpassung**

*Man zählt die maritime Archäologie zu den bedeutendsten geisteswissenschaftlichen Fächern, welche zu dem Agenda für eine globale nachhaltige Entwicklung beitragen könnten. In diesem Artikel erforscht die Verfasserin die Relevanz von maritimen archäologischen Untersuchungen für Klimaschutzinitiativen. Der Beitrag von verschiedenen kürzlich durchgeführten Projekten wird besprochen und die Übereinstimmung von deren Absichten und Ergebnissen mit den Zielen für nachhaltige Entwicklung der Vereinten Nationen wird bewertet. Dies unterstreicht die Vorteile einer Beteiligung der maritimen Archäologie im Streben nach Nachhaltigkeit und Anpassung an die Auswirkungen des Klimawandels. Solch eine Einbeziehung könnte eine wichtige Rolle bei einer menschengerechten und kulturbewussten Lösung der Probleme des heutigen Klimawandels, der Bevölkerungen besonders in Küstenregionen Einbeziehung. Die Verfasserin hofft, dass diese Besprechung als Anreiz für den Einsatz der Kompetenzen von Geisteswissenschaftlern und Archäologen (besonders im Bereich der maritimen Archäologie) dienen kann. Zusammenarbeit im Rahmen der Ziele für eine nachhaltige Entwicklung kann eine bessere Zukunft gestalten. Translation by Madeleine Hummler*

*Stichworte:* maritime Archäologie, Kulturerbe, Klimawandel, Nachhaltigkeit, Klimaanpassung