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Report on the survey “Mapping the vulnerability of cultural and natural monuments/sites from natural and anthropogenic climate change impacts”

CLIMATE CHANGE IMPACTS ON CULTURAL HERITAGE:
FACING THE CHALLENGE



Co-ordination Unit
Flexible Mechanism
November 2022

REPORT ON THE VULNERABILITY OF CULTURAL AND NATURAL MONUMENTS/SITES FROM NATURAL AND ANTHROPOGENIC CLIMATE CHANGE IMPACTS

1. Introduction

With the support of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the World Meteorological Organization (WMO), the Hellenic Republic's proposal, "Addressing climate change impacts on cultural and natural heritage," was introduced at the UN Climate Action Summit in September 2019. Up to this point, the UN Secretary-General (UNSG), the Council of Europe, numerous non-governmental and other organizations (e.g., ICOMOS, SDSN, Europa Nostra, GEO UHCO), and more than 100 UN member states have publicly declared their endorsement for the Greek initiative.

According to the UNSG's "Report on the 2019 Climate Action Summit and the Way Forward in 2020" the Greek effort is one of the most ambitious ones. Greece, UNESCO, WMO, and UNFCCC have all joined forces to form a Flexible Mechanism (FM) to carry out this initiative, with the help of a Coordination Unit (CU) that the Greek Prime Minister established. Under the direction of the FM, the CU aspires to, among other things, increase awareness, facilitate and improve the supporting States' activities in a coordinated manner, and bridge the gap between scientific knowledge and climate adaptation methods.

Climate change poses increasingly negative effects on natural and cultural assets. In order to map significant cultural and natural heritage assets that are endangered by climate change impacts, the CU has designed a questionnaire that was sent to supporting States. The ultimate goal of this exercise was to utilize the findings to create a database that maps and digitizes the proposed sites, contains data on the hazards, best practices, studies, strategies, and measures, and identifies lessons learned and policy gaps. The CU has taken over the mandate of gathering, analyzing, and disseminating the resulting information as necessary.

The questionnaire included both multiple-choice and open-ended questions, the latter with a 150-word maximum limit.

2. Cultural heritage vulnerability due to climate change: Policy framework

The adverse impacts of climate change on cultural heritage, and the urgency of addressing this challenge has created the compelling need for its strategic integration into disaster risk reduction and sustainable development plans. The development of a policy framework that safeguards heritage properties along with sustainable development has proved to act as leverage for successful decision-making processes. International bodies and organizations have supplied guidelines and action plans for addressing climate change disasters. Moving in the same direction, the FM initiated its endeavor in 2007, establishing a reliable and applicable policy framework, which resulted in this report document. The timeline below depicts the development of the FM, from creation to policy establishment and present day.

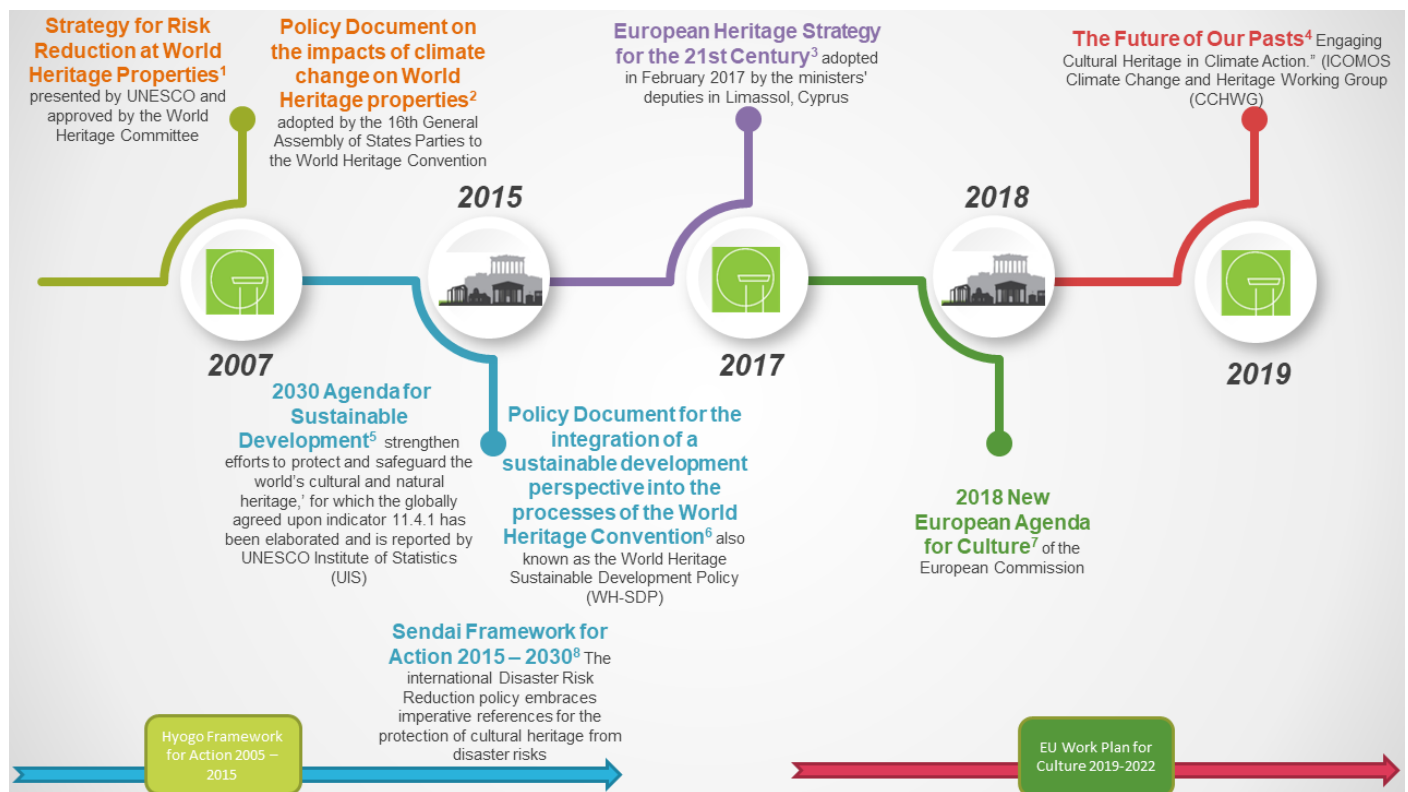


Figure 1 The policy framework, which inaugurated the concern of climate change impacts on cultural heritage (1. <https://whc.unesco.org/archive/2007/whc07-31com-72e.pdf>, 2. <https://whc.unesco.org/uploads/activities/documents/activity-397-2.pdf>, 3. <https://rm.coe.int/16806f6a03>, 4. <https://indd.adobe.com/view/a9a551e3-3b23-4127-99fd-a7a80d91a29e>, 5. <https://sdgs.un.org/2030agenda>, 6. <https://whc.unesco.org/en/sustainabledevelopment/>, 7. <https://whc.unesco.org/en/sustainabledevelopment/>, 8. <https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030>)

3. Cultural heritage vulnerability due to climate change: Projects and initiatives

Numerous national and international research projects and initiatives related to the potential impact of climate change on cultural heritage assets have been carried out. As can be seen in the graphs below, the relevant projects and initiatives deal with principles of cultural and natural heritage protection by providing innovative tools and methods for facing climate change and natural hazards.



Figure 2 Research projects that deal with cultural heritage vulnerability due to climate change (1.<https://cordis.europa.eu/project/id/501837>, 2.<https://www.climateforculture.eu/>, 3.<https://www.interreg-central.eu/Content.Node/ProteCHt2save.html>, 4.<https://www.interreg-central.eu/Content.Node/ProteCHt2save.html>, 5.<https://www.hercules-landscapes.eu/>, 6.<http://www.prothego.eu/>, 7.<http://www.heracles-project.eu/>, 8.<https://www.rescult-project.eu/>, 9.<http://climascape.prd.uth.gr/en/home-english/>, 10.<https://warmestproject.eu/>, 11.<https://www.interreg-central.eu/Content.Node/STRENCH.html>, 12.<https://shelter-project.com/>, 13.<https://www.ruritage.eu/>, 14.<https://rockproject.eu/>, 15.www.storm-project.eu, 16.<https://athena2020.eu/>)

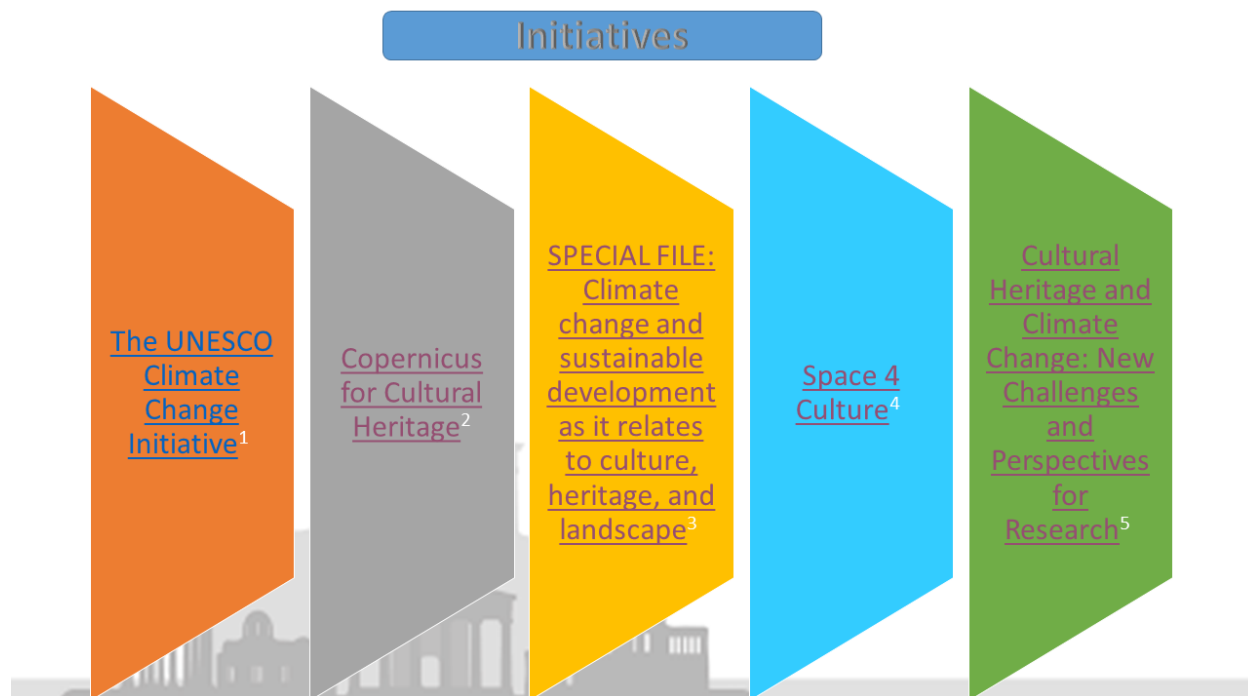


Figure 3 Initiatives related to cultural heritage vulnerability due to climate change
 (1. <https://en.unesco.org/themes/addressing-climate-change>,
 2. <https://www.copernicus.eu/en/copernicus-cultural-heritage-satellites-preserve-legacy-our-past>,
 3. <https://www.coe.int/en/web/cdcp-committee/special-file-climate-change>,
 4. <https://www.eurisy.eu/about/thematic-areas/space-4-culture/>, 5. <https://www.heritageresearch-hub.eu/white-paper-cultural-heritage-and-climate-change-new-challenges-and-perspectives-for-research/>)

4. Who participated?

The profile of participants was used to collect key geographical information about national level interests and actions related to climate change impacts on cultural heritage, and also to map the relevant competent authorities in charge of relevant policy initiatives based on the questions asked about the survey participants.

Thirty-one countries spanning between Canada and Vietnam (Figure 4) participated, indicating that the survey contains an adequate sample of cases to investigate diverse aspects of the vulnerability of natural and cultural heritage worldwide from climate change impacts.

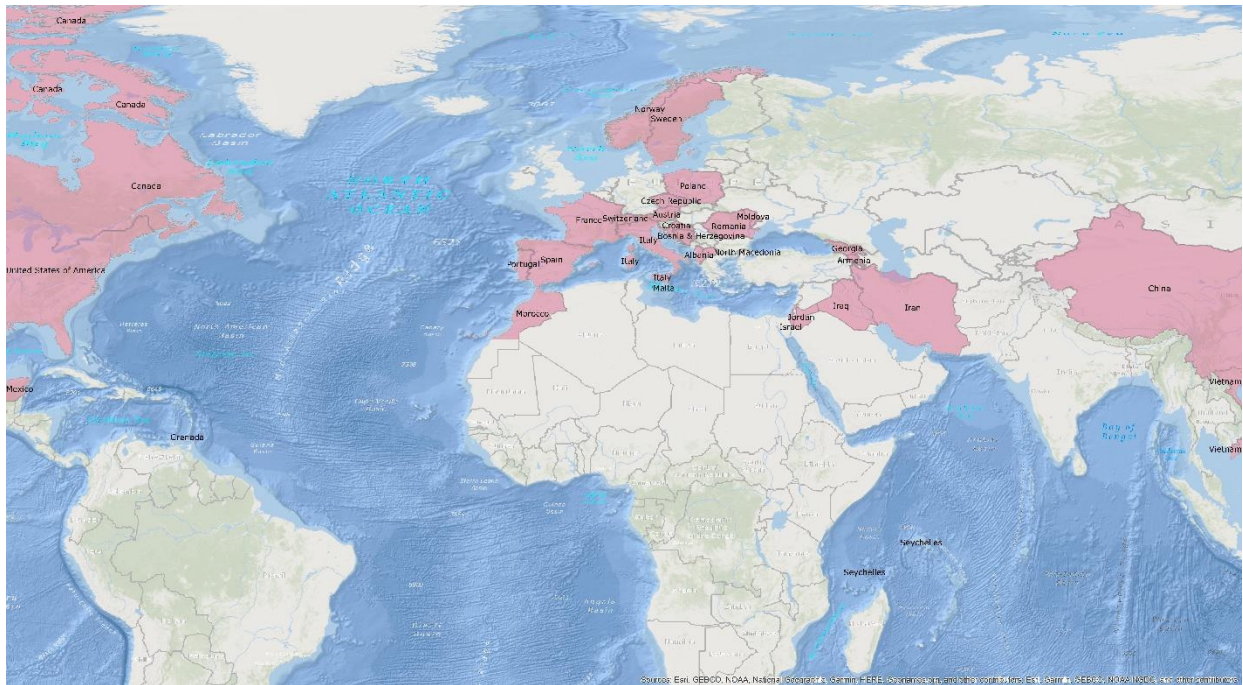


Figure 4 Geographical coverage of the participating countries who completed the survey.

Most of the respondents originated from Europe (18 countries), followed by Asia and North America (7 and 4 countries, respectively), with only 2 countries participating in Africa (Figure 5).

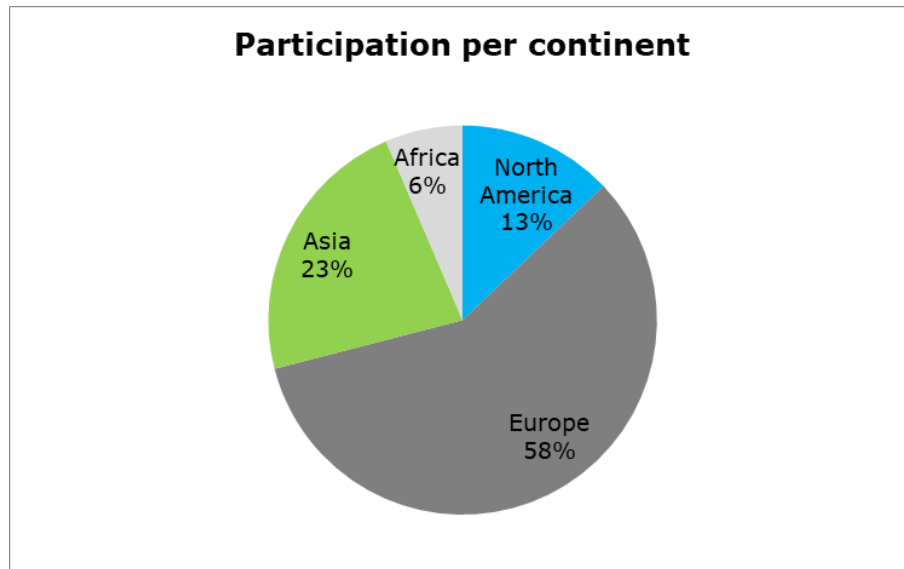


Figure 5 The percentages of participating countries categorized by continent.

Answers were given by the most relevant in climate change and cultural heritage impacts issues authority of each participating country. The involvement was almost balanced between the Ministries of Environment (19 participants) and Culture (18 participants), while in fewer cases the Ministry of Civil Protection (2 participants) was also engaged with the management of the natural and cultural heritage from climate change impacts (Figure 6).

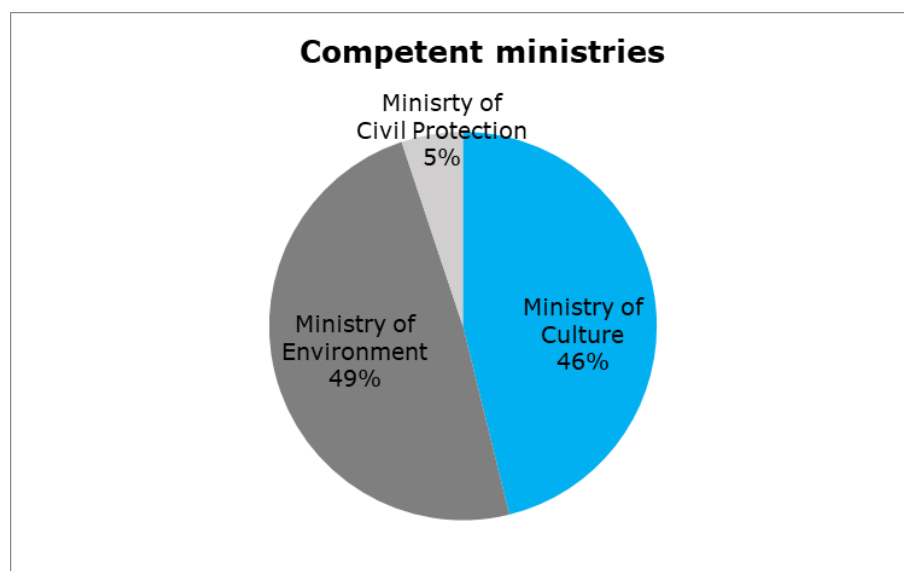


Figure 6 The percentages of participation based on the competent authorities which are related to cultural and natural heritage vulnerability due to climate change impact.

The specialization of the respondents revealed a colorful palette of 10 different specialties with cultural (27 participants) expertise prevailing, followed by experts in climate change adaptation (15 participants) and natural heritage (14 participants), but the participation from experts in climate change mitigation (12 participants per expertise) and mixed heritage was notable. A small percentage of the respondents (9 participants) were experts in landscape planning, climate science, protected areas, international cultural relations, and even a smaller percentage in legal matters (6 participants) (Figure 7).

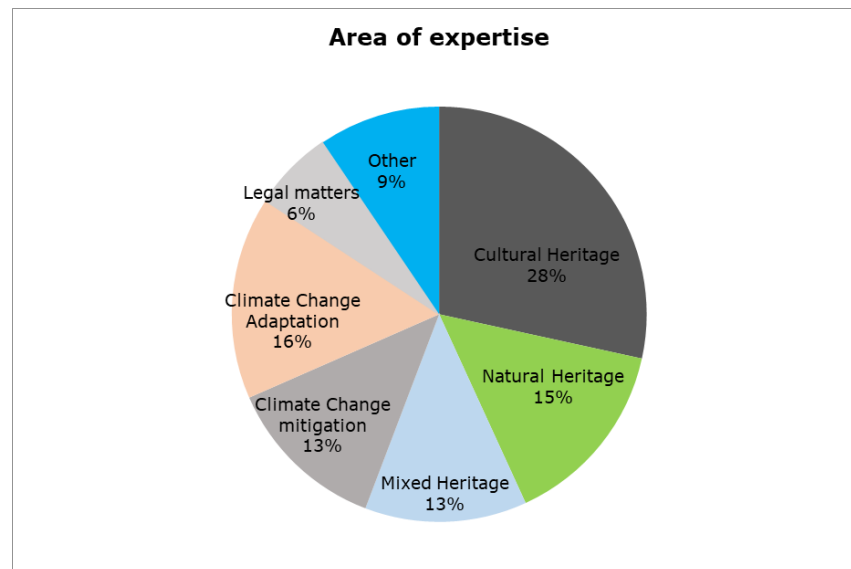


Figure 7 The participation rate of the respondents, which represent the competent ministries, based on their specialization.

What did we find? Most of the participating countries come from Europe, however adequate geographical representation was ultimately achieved. Ministries of Environment and Culture were almost equally represented in completing the survey indicating that reciprocal competence and collaboration in managing cultural heritage preservation from climate change exists. As expected, most of the participants were specialized in heritage protection followed by climate change experts, which suggests the interdisciplinarity of the issue and the urgent need for an integrated collaborative approach from cultural and natural heritage, climate, legal and landscape planning experts.

Survey Structure

The survey comprises of three different sections for the collection of information regarding cultural and/or natural heritage sites threatened by climate change hazards. **Section A** refers to the identification of the cultural and natural heritage

sites — included in the World Heritage List of UNESCO or not — prioritized for protection from climate change impact. **Section B** includes the climate and environmental hazards identified as having a negative impact on the proposed heritage sites, as well as the type of climate related impacts — observed or projected — as a result of the identified hazards. Finally, **Section C** — of general character and not necessarily linked to the proposed sites — refers to the national adaptation plans, good practices, services and tools possibly used for the adaptation of cultural and natural heritage to climate change impacts.

4. A. Mapping Cultural and Natural Heritage Sites threatened by Climate Change impacts

It is of vital importance to identify the most vulnerable/at risk heritage sites with the aim of performing the most effective adaptation and mitigation strategy approaches by mapping the legislative, administrative, climatic, environmental and societal background.

The first question was to identify cultural and natural heritage sites of high priority for protection from climate change impacts. According to the replies, 79 sites were noted that belong to UNESCO World Heritage List, while 62 do not (Figure 8). Among these 141 prioritized sites, 90 are cultural sites, 28 natural and 23 mixed (Figure 9).

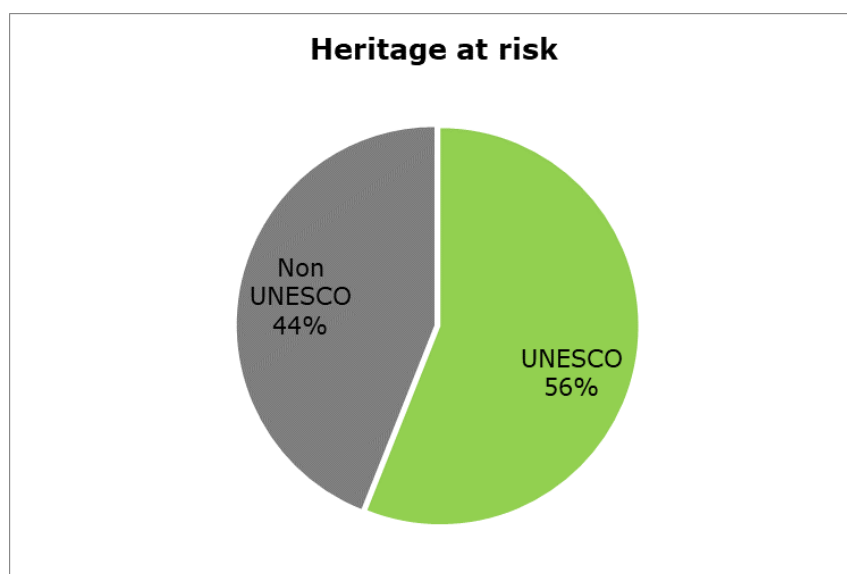


Figure 8 The proposed cultural and natural heritage sites at risk divided into those that are inscribed in the UNESCO World Heritage List and those that are not.

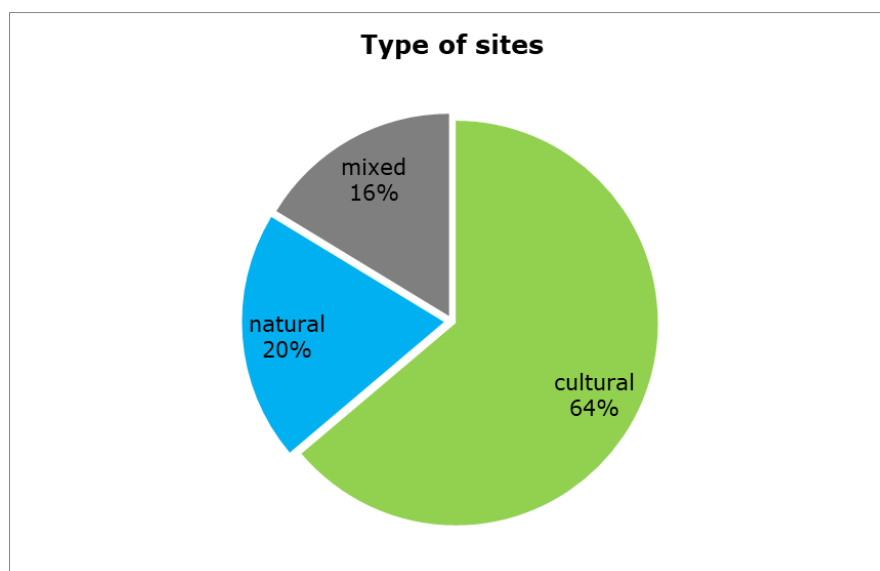


Figure 9 Graph indicating the type of the proposed sites at risk (cultural, natural, or mixed).

Annex 1 includes all information provided for the 141 high priority for protection against climate change sites.

Next, it was asked if the 28 natural sites are included in any transnational protection network (apart from UNESCO Biosphere Reserves or the Natural Heritage Sites). 15 networks were recorded (Table 1) with diverse characteristics that are analyzed in Annex 2.

Table 1 Transnational networks of natural sites that should be part of this initiative, according to respondents' replies.

Network	Number of Sites	Geographical Extent
Ramsar	2331 sites	Global
MaB Biosphere Reserves	727 sites	International
NAMPAN	>1000 sites	Regional
RedParques	23 sites	Regional
Natura 2000	27312 sites	International
WCPA World Heritage Network	13 sites	Global
Europarks	56 sites	International
Global Geoparks Network	169 sites	Global
European Diploma of	>60 sites	International

Protected Areas		
Naval History and Heritage Command		National
American Battle Monuments Commission		National
United States Department of Defense POW/MIA Accounting Agency		National
World Monuments Watch List	700 sites	Global
Emerald network international		International

What did we find? Only half of the recorded sites are part of UNESCO's World Heritage sites, indicating a considerable gap that is vital for their preservation, especially since these sites are mentioned by the competent national authorities of the participating countries as at risk/vulnerable to climate change. As far as the proposed transnational networks of protection are concerned, quite a broad range of initiatives were introduced by the respondents, mostly referring to existing networks of protected natural areas. This information could contribute towards integrating various, yet cooperative and sometimes spatially and/or conceptually overlapping, initiatives aimed at addressing climate change impacts on natural monuments/sites and the surrounding natural environment.

4. B.1. Identifying and assessing climate hazards and impacts of the sites mapped in Section A1

Mapping the environmental hazards that affect cultural and natural heritage sites provides valuable insights into the causes and intensity of vulnerability. If the driving parameters are identified, then effective mitigation and adaptation measures can be applied to safeguard our cultural and natural heritage.

Given a pre-defined list of climate and environmental hazards, the respondents were asked to identify, on a scale from low-to-high, the ones that have a negative impact on the above-mentioned cultural and natural heritage sites. Based on the 30 replies concerning 132 sites of high protection priority, **air temperature change** was the

highest-scored as it was mentioned in relation to 62.9% of the total sites, followed by **humidity change** (53%), **extreme rainfall events** (51.5%), **changing seasonality** (52.3%), **drought frequency and severity** (47.7%), **flood intensity and frequency** (44.7%), **storm intensity and frequency** (43.9%), **change in fire risk** (41.7%), **change in wind** (40.2%), **air pollution** (37.9%), **wildfires** (30.3%), **urban expansion** (29.5%), **sea level rise** (27.3%), **storm surge** (26.5%), **water temperature change** (20.5%), **ocean acidification** (18.2%), **changing ocean currents** (16.7%), **ocean heat events** (15.2%), **land ice melt/glacier retreat** (12.1%), **ocean deoxygenation** (12.1%), **sea ice melt** (8.3%) and **permafrost thaw** (7.6%), while **other hazards** (i.e. freezing - thawing cycles, trend of a mild reduction in water flow, increase of the intensity of precipitation, seismic zone/ landslide, pests, dust, desertification, ground water changes, soil erosion, garbage platform in the vicinity of the site, evapotranspiration, cultural changes and traditional land uses) were mentioned in 11.4% of the sites (Figure 10).

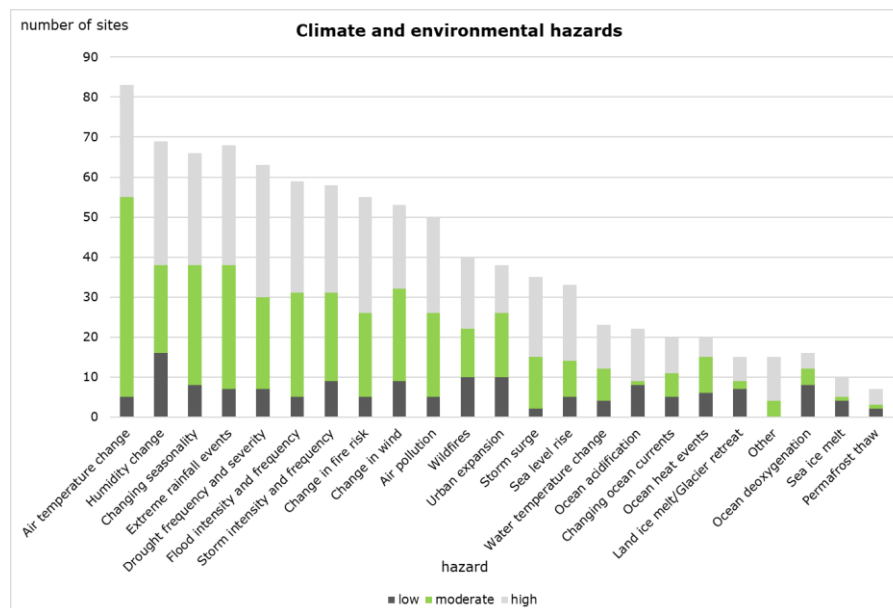


Figure 10 Mapping of the climate and environmental hazards affecting the recorded cultural and natural sites. The graph demonstrates the number of the sites impacted by the corresponding hazard sorted by the highest to the lowest value. It is also indicated the level of risk (high, moderate, and low).

Then, the various climate hazards were clustered under 7 different categories (A: climate change, B: urbanization, C: wind changes, D: ice melting effects, E: ocean conditions, F: fire events, and G: other hazards-as identified by the respondents) to explore spatial patterns of occurrence. According to the findings, countries occupying a great surface area mostly in the middle latitudes indicate ice melting effects as the prevalent high-scored hazard, whereas several countries spread in Europe and other contents mostly identify climate change induced hazards. Last but not least, an

interesting pattern discerned for the Mediterranean countries (also including Norway) was detected concerning wildfires and the change in fire risk. It's also worth mentioning the case of Grenada where both ice melting effects and fire events were mentioned as the most important hazards for the region. With view to comprehending, but also visualizing, the climate change hazards indicated per country a clustering method was conducted. We grouped hazards into 7 general categories: A. hazards directly related to climate change, B. hazards due to urbanization, C. hazards occurring due to wind changes, D. hazards related to ice melting effects, E. hazards due to ocean conditions, F. hazards occurring due to fire events, and G. other hazards. Then, we were able to identify the prevailing climate hazard category for each country by summing up the individual responded hazards that each country participant indicated. In this way, specific geographical patterns per country revealed in relation to climate hazards (Figure 11).

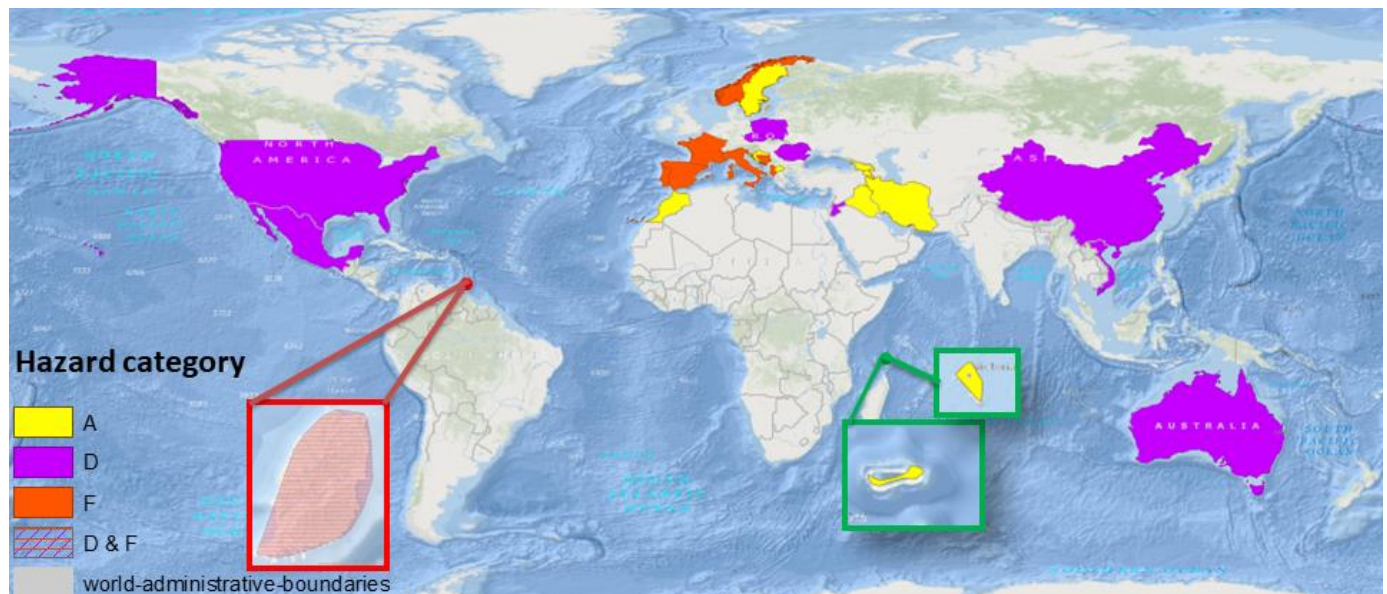


Figure 11 Mapping the climate hazards under 7 general categories (A: climate changes, B: urbanization, C: wind changes, D: ice melting effects, E: ocean conditions, F: fire events, and G: other hazards).

Table 2 includes the description of all climate hazard impacts mentioned in the 132 cultural and natural heritage sites.

Table 2 Examples of climate hazards' impact on cultural and natural heritage. The texts below are the original statements of the participants.

Country	Examples
Armenia	<p>Khoranashat monastery, Tavush region. Khoranashat Monastery /state index 10.51.9 - 10.51.9.6/ is endangered by climate change. It is an excellent example of the medieval architecture of the country, located in the northeast, "near the border with Azerbaijan, surrounded by a forested landscape." It used to be a remarkable cultural center with a "monastic complex" and a university. Today the church continues to function as the only place of worship in the nearby villages of Chinari and Aygedzor. The monument is in a seismic zone prone to landslides. It was included in the list of 7 most endangered monuments during the "Europe Nostra" award ceremony.</p> <p>Tapi Fortress, Ararat region. The other monument endangered by landslides is Tapi Fortress, the fortress of Governor Gevorg. Tapi Fortress or Gevorg Marzpetuni Fortress /state index 3.95.2 - 3.95.2.2 / is of great architectural and fortification value which is located 6 km north-west of Urtsadzor village, on the right bank of the Khosrov river, on the north-western edge of Urts town, on a hill surrounded by mountains. In 2007, the wall of the castle collapsed due to a landslide. Being in a seismic zone, landslides pose a constant threat to the protection of the monument. The location of the monument complicates the implementation of conservation works.</p>
Albania	<p>Water levels fluctuation causing flooding, erosion and pressure on mosaic floors and treatment is required to prevent the build-up of algae and mosquito larvae. Projected rises in the level of the Ionian Sea associated with global warming could, and probably will, inundate large areas of cultural heritage values as recognized in a recent report in Nature. Reimann, L. Athanasios, T V, Brown S, Hinkel J, Tol R S J (2018), Mediterranean UNESCO World Heritage at risk from coastal flooding and erosion due to sea-level rise. Nature 16 October 2018.</p>
Czech Republic	<p>The impact of climate change is evident in terms of manifestations of excessive drought with direct impact on ground water levels. The trees are gradually drying out and later dying or they are attacked by various insects (wood-destroying) or fungal diseases.</p> <p>Currently, our biggest problem is the bark beetle overpopulation. They have destroyed whole areas of our landscapes and parts of historical parks (Pruhonice park). Through all presented levels of protected areas, we realized very deteriorated health condition of trees, which has a strong influence on the composition of the green monuments. (Opočno country house – spruces forest dried out)</p> <p>The drop in ground water is reflected not only in the vegetation component of the monuments, but also in the building. Climate changes also bring very fast and intensive damages, especially after windstorms and floods. For example, Floods in Veltrusy chateau.</p> <p>A major threat would be decrement of ground water level in effect on stopping fresh water supply to the wooden pilots' fundaments of the Baroque monasteries. This would have catastrophic consequences leading to buildings collapse. (Plasy monastery)</p>
Sweden	<p>Temperatures rise and are expected to rise more in the northern part of Sweden, humidity rises in some parts and periods of drought are more frequent in others, whereas the sea level rise is expected to have a greater impact in the southern parts of the country. Gammelstaden is experiencing higher moisture levels, which affects the wooden buildings with rot and pests. Laponia is an area vulnerable to the temperature changes, reindeers</p>

are for example affected in different ways, which affects the landscape and the people. The High coast might be affected by the sea level rise, since the OUV:s are connected to the uplifting of the land, which might not be apparent in the long run. Tanum is affected by air pollution, which can ruin the stone on which the carvings are made. Öland is experiencing both droughts and lack of water. With no water for the cultivation of the landscape the OUV:s are threatened.

Norway	Information sources for climate risk management of northern historic places (Adapt Northern Heritage toolkit) (interreg-npa.eu).
China	Wenxing Bridge, Xuezhai Bridge and Wechong Bridge in the cluster of Taishun Roofed Bridges were destroyed in the flood due to the impact of the strong rainfall brought by Typhoon Meranti during the Mid-Autumn Festival in 2016. Their restoration works were completed in 2017 and announced this year as Cases of Cultural Heritage Recovery and Reconstruction by ICCROM and ICOMOS. Zhenhai Bridge suffered severe damage on 7 July 2020 due to the impact of extreme rainfall events. The bridge deck was destroyed and bridge piers badly damaged. Its repair works are ongoing under the guidance of the National Cultural Heritage Administration.
Grenada	The changes in the landscape can be roughly seen in historical satellite images provided by Google Earth. Based on these images, it seems that major erosion occurred sometime between 2005 and 2014. The beach at Black Bay recovered a bit, but severe damage had already been done. It now seems that we are in another period of erosion which may remove more archaeological materials. Thus, while the beach may recover, the archaeological material within will be lost forever.
France	Climate change threatens all World Heritage properties (3rd main threat to World Heritage sites, 1st threat to natural sites), at different scales and with different parameters and climatic phenomena, depending on the context of each site. In France, the main impacts are expected to be: rise in temperatures, particularly in the regions furthest from the coast; increasingly frequent and severe heatwaves; less severe and less frequent cold waves; more intense rainfall; more frequent and severe droughts; increase in the severity of storms and cyclones, especially in ultra-marine territories; and sea level rise.
Jordan	For example, flash floods in Jordan have killed 11 people and forced the evacuation of nearly 4,000 tourists from the ancient city of Petra in November 2018. Downpours also triggered a state of emergency in the port city of Aqaba. It comes two weeks after 21 people, mostly children, drowned in a flash flood in the Dead Sea area near Al-Maghtas.
Malta	The main wetland sites include: Ghadira Nature Reserve, Simar Nature Reserve, Salina Nature Reserve, and il-Magħluq at Marsaxlokk. Woodlands: Buskett, Mizieb, and Bidnija olive grove, Offshore islands: Filfla, Fungus Rock (Gozo), Comino and its satellite islands, and St. Paul's Islands. Coastal cliffs: Benghisa to Ghar Lapsi, Dingli Cliffs to Qammieh point, Ras in-Newwiela to Gharb in Gozo. Underground sites: Ghar Dalam, Ghar ta'I-Iburdan, Rabat. All sites form part of the Natura 2000 network.
USA	Examples of identified threats are provided in the supporting document, " Climate Change Impacts on Cultural & Natural Heritage: USA. "

What did we find? Changes in air temperature and humidity were recorded as the prevalent hazards that cultural and natural heritage sites face today. This information frames the necessary strategic actions that should be put into practice to adopt smart, sustainable, resilient, and efficient solutions to confront specific climate change hazards. Respondents also mentioned other hazards mostly due to slow onset events.

4. B.2. Identifying and assessing climate impacts of the sites mapped in Section A1.

Identifying the complicated underlying mechanisms of the impacts of climate change on cultural and natural heritage could significantly contribute towards the successful implementation of mitigation and adaptation measures for the protection of cultural and natural heritage sites, especially for the sites that are not registered in the World Heritage List, and where policy measures or strategic plans are more difficult to put in place.

Having identified the observed and/or projected hazards (section 4B1) threatening the cultural and natural heritage sites, the respondents were asked to point out climate-related experienced and/or projected impacts, especially in the case of cultural/natural heritage sites that are not included on the World's Heritage List of UNESCO. According to the findings, **increasing property costs** are considered the most threatening impact (88.2% of total sites) followed by **impacts on tourism** (79.4%), **damage** (69.1%), the **degradation of OUV** (66.2%), **scenic beauty** (64.7%), **biodiversity** (47.1%), **impacts on ecological integrity** (42.6%), the **loss or degradation of intangible heritage** (41.2%), **landscape changes** (36.8%), **economic losses** (29.4%), **impacts on local communities** (26.5%), **water shortages or food insecurity** (23.5%), **forced mitigation** (19.1%), **conflicts or violence** (17.6%), **diminished capacity to address to local communities** (16.2%) and **impacts on geological heritage** (16.2%) (Figure 12). Landscape changes, water availability and pollution of current infrastructure projects were also suggested by the participants as potential projected climate-related impacts.

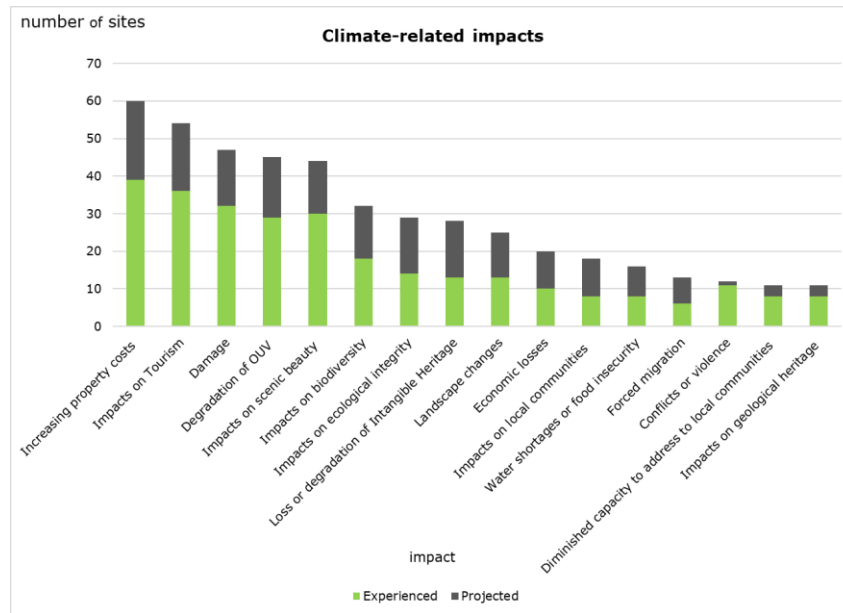


Figure 12 Identification of climate-related impacts on cultural and natural heritage sites (not included in UNESCO’s World Heritage List). The number of the sites for each identified impact is shown, sorted from highest to the lowest value. It is also indicated if the impact is experienced and/or projected.

The various climate-related impacts were clustered similarly with the hazards, under 8 different categories (A: climate change, B: anthropogenic, C: fire, D: water, E: ice, F: marine environment, G: drought, and H: wind-as these were identified by the respondents) to identify any spatial patterns of occurrence. Again, countries occupying a great surface area indicate anthropogenic impacts as the prevalent high-scored experienced impact, whereas coastal countries identify water related impacts as the most severe experienced hazard. A certain pattern in European countries is also observed, with most of them indicating climate change impacts (expected and projected) as the most severe ones. It’s worth also mentioning that in this case of clustering, there are many overlaps between various categories, especially climate change, anthropogenic and fire –related impacts. To understand, but also visualizing, the climate-related impacts indicated per country the clustering method was again implemented. We grouped impacts into 8 general categories: A. impacts of climate change, B. anthropogenic impacts, C. impacts due to fire events, D. impacts caused by water phenomena, E. impacts due to ice events, F. impacts related to the marine environment, G. impacts due to droughts and E. impacts due to wind effects. Then, we were able to identify the prevailing climate-related impacts category for each country by summing up the individual responded impacts that each country participant indicated. In this way, specific geographical patterns per country revealed in relation to climate-related impacts (Figure 13).

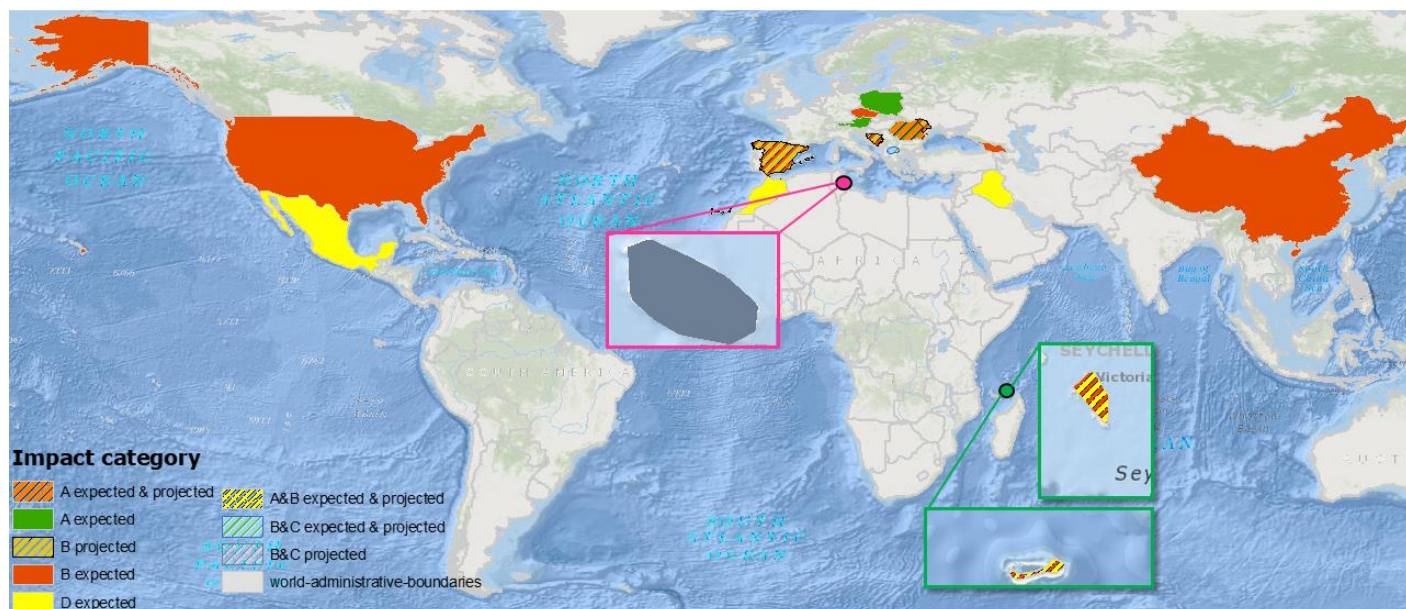


Figure 13 Mapping the climate-related impacts under 8 general categories (A: climate change, B: anthropogenic, C: fire, D: water, E: ice, F: marine environment, G: drought, and H: wind).

An example was mentioned by China, where water-related impacts have been identified as severe climate-related impacts on cultural heritage. More precisely, there was a severe damage to Wenxing, Xuezhai and Wechong Bridge, in the cluster of Taishun Roofed Bridges, due to strong rainfall brought by Typhoon Meranti in 2016. As a result, about 12,900 residents needed to be relocated. The restoration entities installed sensors at key parts of the bridges to conduct real-time monitoring of bridge load-carrying capacity. At the same time, the new testing system was established to strengthen tests of river basins within boundaries of the heritage properties.

What did we find? Most of the identified impacts refer to economic ramifications, revealing the multi-dimensional and complicated nature of climate change impacts on cultural heritage elements and the surrounding landscape. Yet, direct environmental impacts (e.g., on biodiversity and ecological integrity as well as landscape changes) are not considered as important as the economic ones. A lot of effort needs to be put into environmental awareness and the promotion of good practices to emphasize the nexus of environmental protection and climate change adaptation.

4. C. Adaptation of Cultural and Natural Heritage to the impacts of Climate Change

The inclusion of cultural and natural heritage protection into climate change adaptation frameworks will allow for the identification of adaptation needs per country in order to implement effective strategies for the protection of vulnerable communities and cultural heritage assets. Further, it will enable the assignment of responsibilities to competent authorities, cross-sectoral participation and the exploration of legal initiatives that would safeguard cultural and natural heritage from climate change impacts.

29 out of the 30 responding countries indicated that there is a national climate change adaptation framework or strategy in place (Figure 14), which is a promising as far as the policy priorities and initiatives are concerned for tackling climate crisis.

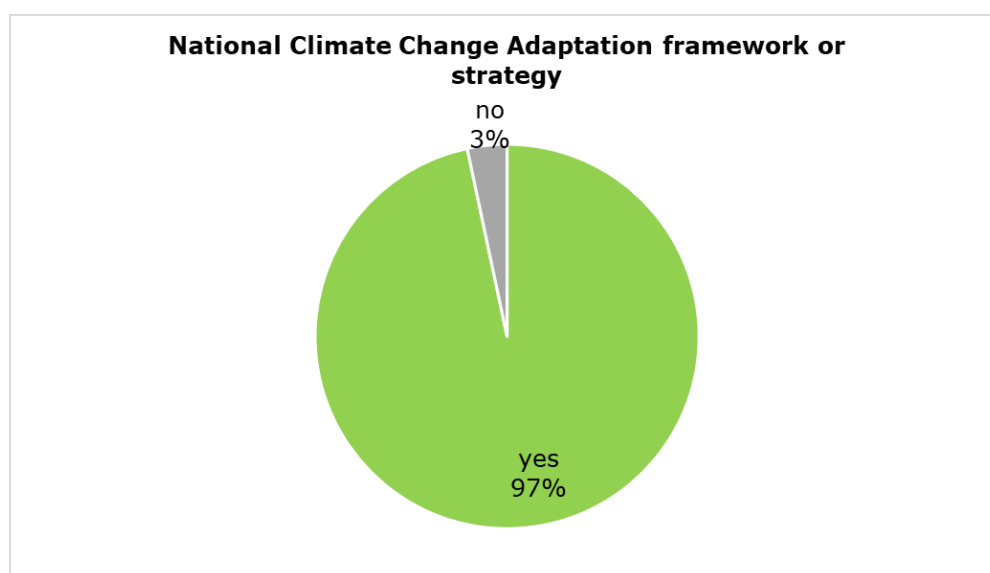


Figure 14 Percentages indicating the adoption of national climate change adaptation framework or strategy by the participating countries.

When respondents were asked if there is a chapter dedicated to cultural/natural heritage, 18 out of 30 countries replied positively, while 8 countries indicated the absence of such a chapter/sector in strategy frameworks (Figure 15).

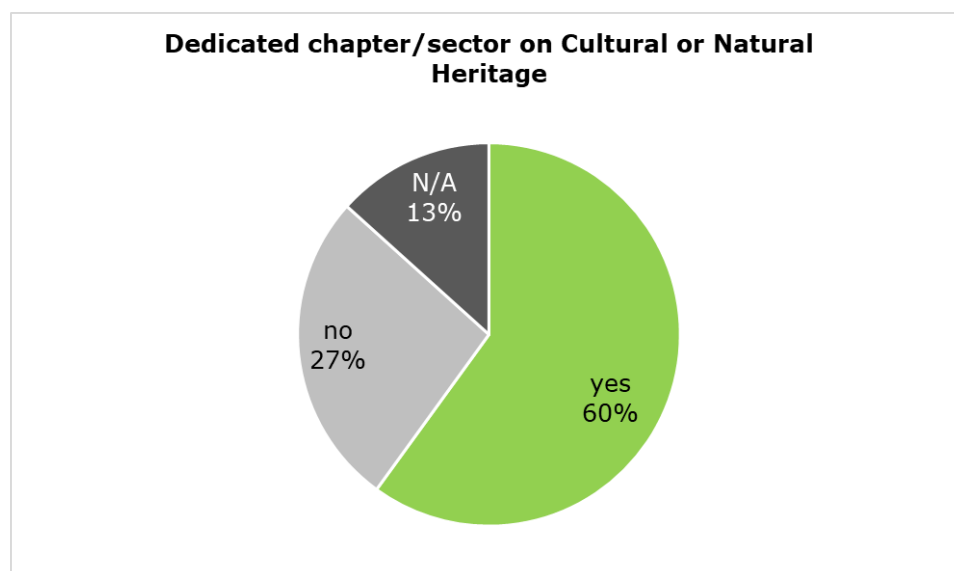


Figure 15 The graph shows (percentages) the inclusion of natural and cultural heritage in the national climate change adaptation frameworks adopted by the responding countries.

The next question concerned the inclusion of cultural or natural heritage into other chapters/sectors (e.g., land use, forestry, agriculture, cities), urging respondents to point out these chapters/sectors. Among 21 replies, the chapter/sector of integrated multi-sectoral initiative/sustainable development prevailed with 12 replies followed by the protection of the environment/biodiversity sector with 3 replies. The physical planning issues and urban and regional development followed with 2 replies. The sectors of land use, forestry, agriculture and tourism appeared next, with 1 reply each (Figure 16). Finally, there are 2 replies mentioning that there is no inclusion of cultural or natural heritage into other chapters/sectors.

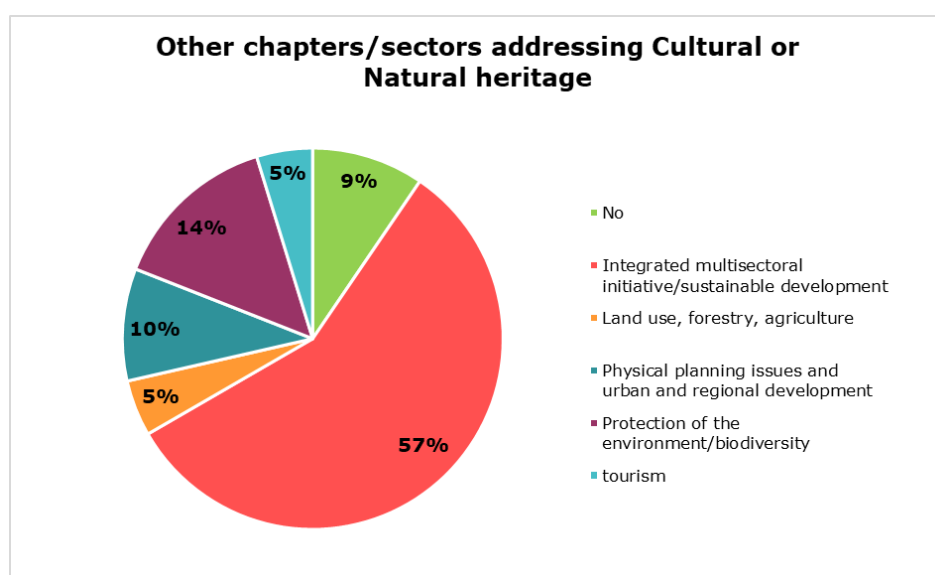


Figure 16 Other chapters and sectors in which cultural and natural heritage is incorporated by the participating countries, expressed in percentages.

What did we find? Almost all the participating countries declared that they have already adopted a national climate change adaptation framework or strategy and most of them have also included cultural and/or natural heritage aspects into this legislative framework. Another promising finding is the integrated multi-sectoral approach, under which cultural and natural heritage is incorporated into the national adaptation plan, indicating that the protection of cultural and natural heritage is established under the umbrella of climate change adaptation strategy approaches. Preservation can only be achieved if the impacts of climate change on cultural and natural heritage are considered within integrated initiatives. This urgent international need for the incorporation of cultural heritage protection into climate change adaptation policies is being implemented at the legislative level by many of the responding countries.

Good practices and studies that promote adaptation/resilience of cultural and natural heritage to climate change impacts (Annex 3) show the actual establishment of related mechanisms or the policy priorities in each country. Under this framework, respondents were asked to indicate whether such practices are already incorporated in existing mechanisms (7 out of the 24 replies) or climate-specific initiatives (17 out of the 24 replies) (Figure 17).

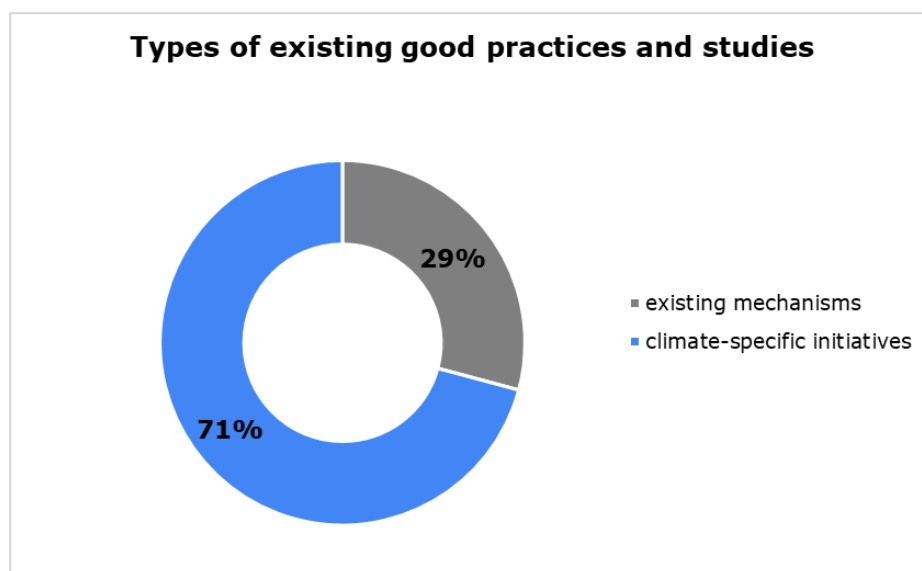


Figure 17 The chart displays the type of existing good practices and studies carried out by the participants for the adaptation/resilience of cultural and natural heritage, expressed in percentages.

What did we find? There is lack of existing mechanisms explicitly focused on cultural and natural heritage protection. Most of the initiatives are under the climate action framework, which potentially reveals an inefficient strategy for the protection of cultural heritage. On the other hand, an integrated climate specific initiative incorporating cultural assets is quite promising in terms of effective adaptation and resilience. The incorporation of cultural and natural protection into the national climate change adaptation policies is also reflected at the local level through existing good practices and studies described by the respondents.

The participants were also asked to describe techniques, technologies and IT/digital economy tools used for the adaptation/resilience of cultural and natural heritage in their country. 19 out of 21 participants pointed out the use of climate modelling, whereas 16 respondents indicated satellite data as adaptation/resilience tools of cultural/natural heritage. Others mentioned drones (8 replies), technology for climate proofing (7 replies), artificial intelligence (5 replies) and early warning systems (meteorology, 2 replies) (Figure 18). There were 9 replies mentioning examples of tools and techniques used for adaptation/resilience of cultural and natural heritage, which are depicted in detail in Table 4.

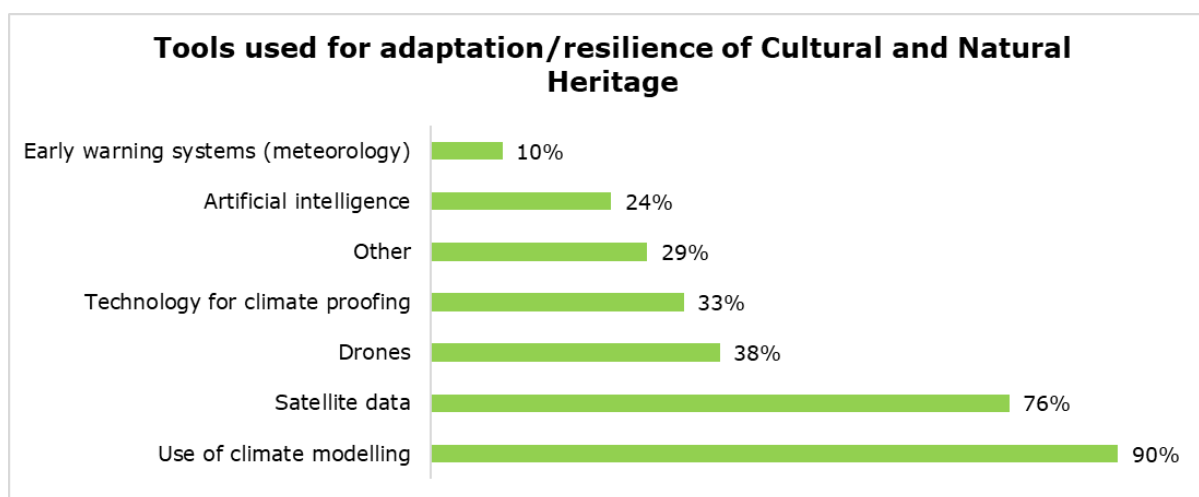


Figure 18 Tools used for the adaptation/resilience of cultural and natural heritage against climate change. The bars show the percentage of each proposed technique/tool used by the responding countries, sorted by the lowest to the highest.

Table 4 Examples of techniques and tools used for the adaptation/resilience of cultural and natural heritage to the impact of climate change. The texts below are the original statements of the participants.

Country	Example	Authority	Link
Mexico	- The Disaster Prevention Programme for Cultural Heritage (PrevINAH) (2002): uses satellite data, climate modelling from the National Meteorological Service,	Instituto Nacional de Antropología e Historia (INAH), and the Centro Nacional de Prevención	www.previnah.inah.gob.mx/

	<p>and information from other national agencies to establish risk management strategies.</p> <ul style="list-style-type: none"> - CONABIO: Explorador de Cambio Climático y biodiversidad. 	<p>de Desastres (CENAPRED)</p>	<p>https://servicios.conabio.gob.mx/ECCBio/</p>
Spain	<ul style="list-style-type: none"> - Use of climate modelling: Display of more than 120 miniaturized sensors with dataloggers to record air and soil temperature and humidity. - Satellite data: LANDSAT imagery and LiDAR products to analyze landscape changes through time and GPS locator device to monitor daily activity of livestock. - Drones: Granted to carry out two kinds of flights with drones (UAV: unmanned Aerial Vehicle) to monitor the condition of the glacier and identify microclimatic refuges for organisms in the ongoing scenario of climatic change. - Artificial intelligence: PlantNet (2018) app used to identify woody plants. - PlantNet and iNaturalist platforms (2021). - Reusing Posidonia Project”(Balearics). - A pilot study at Formentera analyses the relationship between mass tourism and vernacular constructions. - NATIONAL PLAN FOR ADAPTATION TO CLIMATE CHANGE 2021-2030 Chapter 7.9: Cultural Heritage: “To identify Spanish cultural heritage elements that are more vulnerable to climate change and line out possible adaptation strategies. To include Spanish cultural heritage observations regarding climate change in the Cultural Heritage Preservation Plans (including the National Plans for Cultural Landscape). To identify and transfer vernacular knowledge for the climate change adaptation plan. To enhance cultural and architectural heritage, in contra position to climate change” 	<p>Cultural Heritage Institute in Spain (IPE-CSIC)</p>	<p>https://www.youtube.com/watch?v=eaqKo783z08</p> <p>https://cordis.europa.eu/article/id/418412-satellite-data-improves-european-coastal-management/es</p> <p>http://reusingposidonias.com/(https://www.miteco.gob.es/es/cambio-climatico/temas/impactos-vulnerabilidad-y-adaptacion/casospracticosadaptacioncc_tcm30-523466.pdf)</p>
Vietnam	<ul style="list-style-type: none"> - GIS and remote sensing used to build a system for the prevention and warning of natural disasters and monitoring of natural resources. - Piloted drone in the management and protection of forests. - GPS and SMART management system to patrol the forest, monitor biodiversity and the development of forests, etc. 	<p>The Management Board of Phong Nha-Ke Bang National Park</p>	

China	-	Monitoring Center for World Cultural Heritage Sites in China, which is based in the Chinese Academy of Cultural Heritage: monitoring and early warning for the conservation and management of World Cultural Heritage sites in China, effectively enhancing site managers capacity to react and response to potential risks and threats in cultural heritage sites in the context of climate change.	The National Cultural Heritage Administration
Grenada	-	Sea rise in areas such as the Carenage St. George's and along coastal towns	
Austria	-	The ZAMG is the Central Institute for Meteorology and Geodynamics: the gathering, treatment and storage of results of meteorological and geophysical examinations; advisory and consulting services, advice and warning in cases of crises, incidents, natural and environmental disasters, customer-orientated solutions for construction projects including the risk of earthquakes, vibration measurements, etc.	(Austrian Federal Ministry of Education, Science and Research)
Jordan	-	SWAT model in preparation to 3rd national communication to modeling a climate change in Jordan.	
Malta	-	Analysis and modelling using environmental monitoring data, both national and localized including predictions on habitat changes and the impacts on the local breeding avifauna.	
USA	-	Preparation of climate change scenarios as part of Resource Stewardship Strategies.	The National Park Service Climate Change Response Program

What did we find? Climate modelling along with satellites prevail as the primary tools used for adaptation/resilience of cultural and natural heritage against climate change, revealing the key role of Earth observation (EO) data, products, and services for cultural heritage preservation related activities.

According to the needs expressed by respondents at the national level, professional training, and capacity building lead with 27 replies. Methodologies for the assessment of vulnerability and catalogue of good practices follow with 25 and 23 replies respectively. Related policies and legislation have 21 replies followed by education material with 19 replies. Manual for the drafting of an adaptation plan and lifelong learning activities were both mentioned by 18 respondents (Figure 19). 5 participants pointed out other needs, such as financial support, technical support, database for

studies and specific thematics, research on building assemblies and materials affected by climate impacts, resources and assistance to address the issues.

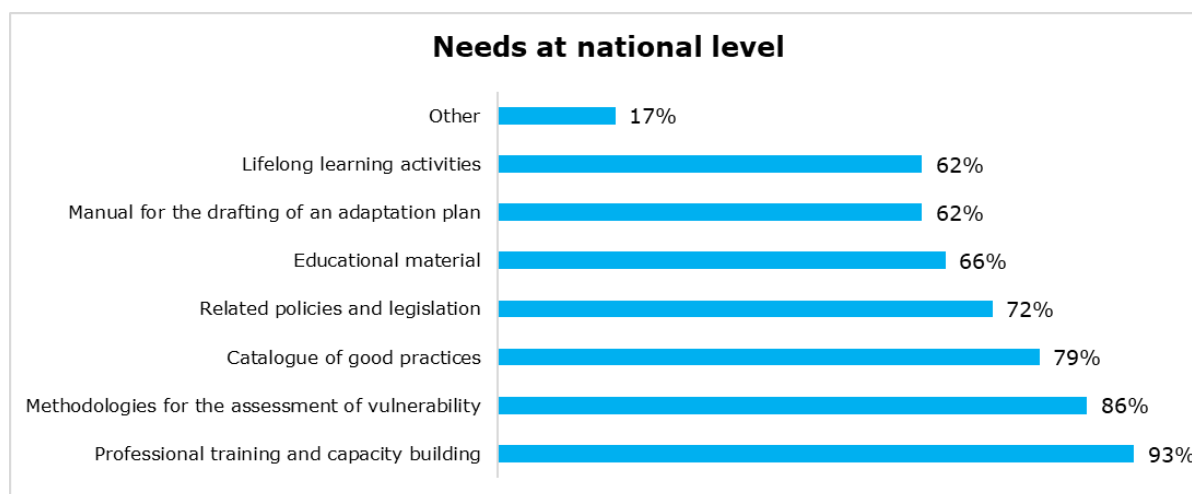


Figure 19 The graph demonstrates the needs reported by the countries - at the national level - to better assess and understand the climate and environmental impacts on cultural and natural heritage. The bars represent the percentage of each need sorted by the lowest to the highest.

What did we find? Most of the participating countries need guidance in capacity building, vulnerability assessment and examples of good practices, highlighting the necessity for consultation at the implementation stage of cultural and natural heritage adaptation/resilience initiatives.

Table 5 contains specific examples of participating countries needs at the national level for addressing climate change impacts.

Table 5 Specific examples with the needs of the participating countries at the national level for addressing climate change impacts. The texts below are the original statements of the participants.

Country	Authority	Example
Morocco		- Development of several regional adaptation plans (need for funding to be implemented).
Poland	The Ministry of Climate and Environment	- Development of documents corresponding to climatic risks (e.g., urban adaptation plans). - Further(?) development of Climate Change Adaptation related guidelines such as "Guidelines for the Urban Adaptation Plans preparation" in 2014 or "Guide to investment preparation respecting climate change mitigation and adaptation as well as resilience to natural disasters" in 2015.
China	Chinese Academy of Cultural Heritage	- The national key research programme, "Risk Assessment and Emergency Response Study on Natural Disasters Affecting Immoveable

			Cultural Heritage” aims to, under the precondition of no intervention to heritage property, carry out risk assessment and emergency response study before, during and after disasters.
USA	Different sectors of the federal government	-	Multifaceted approach that includes aspects of all these activities from developing policies and legislation, advancing good practices, and supporting adaptation planning, among other actions. These activities could be potentially informed and enhanced by international benchmarks and models.

What did we find? The illustrative examples indicate the prevalent needs that were noted in this survey, which include the need for funding, guidance on applied methodological approaches, and the importance of an integrated strategic framework incorporating cultural and natural heritage into climate adaptation initiatives.

The last part of the survey comprised of open-ended textbox where all participants could provide additional comments or information relevant to the questionnaire. Table 6 summarizes this additional information or comments that participants provided.

Table 6 Table with general comments and information from the participating countries regarding the current questionnaire. The texts below are the original statements of the participants.

Country	Comment/information
Mexico	<p>We want to clarify the following:</p> <ol style="list-style-type: none"> 1) Only the World Heritage Properties have the Statement of Outstanding Universal Value (OUV). 2) In Mexico, Natural Protected Areas are one of the best instruments to protect and manage the natural heritage. 3) This questionnaire was answered using national data.
Armenia	<p>In terms of climate change adaptation, the government is pursuing the protection of cultural and historical monuments. The government is currently working on a program package to protect the historical and cultural heritage from the effects of climate change. At present, the Armenian government is trying to take measures to preserve the monuments and adapt them to the changing climate.</p> <ol style="list-style-type: none"> 1) Decision N 749-L of the Government of the Republic of Armenia of May 13, 2021 states "On approving the National Action Plan for Climate Change Adaptation and the list of measures for 2021-2025" 2) Third National Climate Change Message according to the UN Framework Convention on Climate Change 3) Regular monitoring of the condition of natural and historical-cultural monuments and planning of restoration of investment works, preservation of natural and historical-cultural monuments
Czech Republic	Not all damages and degradations are caused by climate change, much more changes in the landscape are related to people's behavior and countryside management.
China	China is a country with a vast territory and hence there are diverse types of climate factors affecting its cultural heritage – from ocean-related factors to rainfall events

to inland desertification. Different types of climate change have different impacts on heritage properties. Wooden structures, stone monuments, grotto temples, wall paintings, bridges, and earthen sites, all require different response measures. Thus, China has accumulated numerous experiences in addressing natural disasters.

We welcome and support Greece's initiative for addressing climate change and protecting cultural heritage. We wish to conduct exchanges with Greek and international colleagues, sharing China's expertise and protecting our common cultural heritage.

Iran

We would appreciate it if you could please provide us with the latest successful studies, resources and materials and global standards for assessment in WHSs.

5. Summary, conclusion, recommendations and follow up

- ★ The survey's findings indicate that 44% of reported cultural and natural sites are not on the UNESCO World Heritage List, and that the Ministries of Culture and Environment share responsibility for mapping and evaluating the vulnerability of assets to the effects of climate change. Therefore, it is crucial that competent authorities improve intergovernmental coordination and review their priorities and plans for preserving their cultural legacy.
- ★ The reported cultural and natural heritage sites experience almost the full spectrum of climate and environmental hazards, necessitating multi-disciplinary and holistic approaches, while it turns out that multi-sectoral impacts are already being noticed in the sites that are not on the UNESCO World Heritage List and are a major cause of concern. This emphasizes the necessity of both local and international action.
- ★ Even though the vast majority of survey respondents (97%) stated that their country has adopted a national framework or strategy for coping with climate change, only 60% of these mention cultural and natural heritage specifically. This shows the need to place the issue higher up on the priority list for climate action.
- ★ It is encouraging that scientifically sound approaches - like climate modeling and data-driven methodologies (for instance Earth observation) - have already been implemented to support decision-making regarding adaptation measures and has increased the resiliency of cultural and natural heritage. However, more advanced methods still are absent. The findings show the necessity of implementing good practices and coordinating mechanisms at multiple levels, along with the urgent need for capacity building, training, and education.

Annex 1

Collective table presenting general information of the proposed cultural and natural heritage sites.

Sitename	Country	Continent	UNESCO sites	Non-UNESCO sites	Cultural	Natural	Mixed
RockPaintings of the Sierra de San Francisco	Mexico	North America	x		x		
Archaeological Zone of Paquimé			x		x		
Pre-Hispanic City of Teotihuacan			x		x		
Historic Center of Mexico City and Xochimilco			x		x		
Pre-Hispanic City and National Park of Palenque			x		x		
Ancient Maya City and Protected Tropical Forests of Calakmul			x				x
Camino Real de Tierra Adentro			x		x		
Las Labradas Archaeological Site				x	x		
Sian Ka'an, Quintana Roo			x			x	
Monarch ButterflyBiosphere Reserve			x			x	
National Park Plitvice Lakes	Croatia	Europe	x			x	
Nature Park Vransko Lake				x		x	
Natura 2000 site Delta Neretva				x		x	
WHS Stari Grad Plain	Georgia	Europe			x		
Varzia cave complex				x	x		
Uplitsikhe cave				x	x		
David Gareja monastery complex				x			x

Historical Monuments of Mtskheta	Armenia	Asia	x		x
Village of Chajashi in Upper Svaneti			x		x
Gelati Monastery			x		x
St. Astvatsatsin Church, RA, Syunik region, Meghri				x	x
Sanahin Monastery Complex			x		x
"Khor Virap" monastery complex				x	x
Khoranashat Monastery				x	x
Tapi Fortress	Romania	Europe		x	x
L'ensemble rupestre de Basarabi				x	x
Early XXth Century Blocks in Bucharest				x	x
Wooden churches of Maramureş	Albania	Europe	x		x
Butrint, Saranda			x		x
Monastery of Saint Mary, Zvërnec, Vlorë				x	x
Monastery of Saint Mary, Krorëz, Saranda				x	x
Castle of Skanderbeg, Rodoni Cape				x	x
Ethem Bej Mosque, Tirana,				x	x
Bryggen	Norway	Europe	x		x
West coast; Vega			x		x
Northern part, coast; Røros			x		x
Plasy monastery, Kratochvíle castle	Czech Republic	Europe		x	x
Hluboká nad Vltavou castle				x	x
Landscape of baroque carriage horses in Kladruby			x		x

Lednice-Valtice Cultural Landscape	Vietnam	Asia	x		x		
West Bohemian Spa triangle			x		x		
Hoi An city, Cua Dai beach			x				x
Hue city			x		x		
Ha Long Bay			x			x	
Phong Nha-Ke Bang National Park			x				x
Citadel of Ho Dynasty	Sweden	Europe	x		x		
Agricultural landscape of southern Öland			x		x		
Church Town of Gammelstad, Luleå			x		x		
High coast			x			x	
Laponian area			x				x
Rock Carvings in Tanum			x		x		
The Skopje Aqueduct	North Macedonia	Europe		x	x		
Stobi				x	x		
Plaoshnik	Spain	Europe	x				x
Garajonay National Park			x			x	
Donana National Park			x			x	
Pyrenees-Mont Perdu (Ordesa y Monte Perdido National Park)			x				x
Teide National Park			x			x	
Castillos de Osma and Ucero, Soria				x	x		
Bahía de Cádiz	Republic of Moldova	Europe		x	x		
Poblado ferroviario de Monfragüe				x	x		
National Park Orhei				x			x
Prutul de Jos biosphere reserve				x			x
The Park of Taul Village				x			x
Toubkal Park	Morocco	Africa		x			x

Oases of the region of Deraa Tafilalet			x	x
Medina of Marrakech			x	x
Medina of Essaouira			x	x
Old city of Bern	Switzerland	Europe	x	x
Venn's Town Mission Ruins	Seychelles	Africa	x	x
Bel Ombre Treasure site			x	x
Mont Signal lookout post			x	x
Wooden Churches of Southern Małopolska	Poland	Europe	x	x
Muskauer Park / Park Mużakowsk			x	x
Auschwitz Birkenau - German Nazi Concentration and Extermination Camp			x	x
Marshes of southern Iraq	Iraq	Asia	x	x
Sawa Lake in Al-Muthanna Governorate			x	x
Bahr Najaf in Najaf Governorate			x	x
The Kingdom of Hatra			x	x
The ancient city of Samarra			x	x
Erbil Citadel			x	x
Monastery of the Hieronymites and Tower of Belém in Lisbon	Portugal	Europe	x	x
Convent of Christ in Tomar			x	x
Royal Building of Mafra – Palace, Basilica, Convent, Cerco Garden and Hunting Park			x	x

Kulangsu, a Historic International Settlement	China	Asia	x		x
Mogao Caves			x		x
Zhenhai Bridge				x	x
Taishun Roofed Bridges				x	x
Cultural Landscape of Honghe Hani Rice Terraces			x		x
Grand Bay Carriacou	Grenada	North America		x	x
The Persian Qanat	Iran	Asia	x		x
Shushtar Historical Hydraulic System			x		x
Hyrcaanian Forests			x		x
Historic Centre of Vienna	Austria	Europe	x		x
City of Graz - Historic Centre and Schloss Eggenberg			x		x
Cultural Landscape Fertö-Neusiedlersee			x		x
Cultural Landscape Wachau			x		x
The old city of Jaffa	Israel	Asia		x	x
The city of Hadare				x	x
The "Hnakin house"					
Swallows at the dead sea				x	x
The Coral reef at the Red Sea				x	x
Mikve Israel				x	x
Agricultural School buildings from the x8th century					
Gulf of Porto in Corsica	France	Europe	x		x
Lagoons of New Caledonia			x		x
French Austral Lands and Seas			x		x
Reunion Island			x		x

Ancient and primeval beech forests of Europe			x			x	
Pyrenees - Mont Perdu			x				x
Marquises Islands in French Polynesia				x			x
North of Martinique Island				x		x	
Petra	Jordan	Asia	x				x
Baptism Site "Bethany Beyond the Jordan" (Al-Maghtas)			x		x		
As-Salt - The Place of Tolerance and Urban Hospitality			x		x		
The Megalithic Temples of Malta	Malta	Europe	x		x		
Tas-Silg				x	x		
Ta' Kaccatura				x	x		
San Pawl Milqi				x	x		
Ramla l-Hamra Villa				x	x		
Ghajn Tuffieha Roman Baths				x	x		
Ras ir-Raheb				x	x		
Hagar Qim archaeological park				x			x
Ghar Dalam				x			x
Natura Sites (Żona fil-Baħar bejn Rdum Majjiesa u Għar Lapsi, Żona fil-Baħar fl-Inħawi ta' Għar Lapsi u ta' Filfla, Żona fil-Baħar fl-Inħawi tad-Dwejra (Għawdex), Żona fil-Baħar bejn Il-Ponta tal-Ħotba u Tal-Fessej (Għawdex), Żona fil-Baħar bejn Il-Ponta ta' San Dimitri				x		x	

(Għawdex) u Il-Qaliet				
Everglades National Park, Florida	USA	North America	x	x
Papahānaumokuākea, northwest of Hawaii Archipelago			x	x
Taos Pueblo, New Mexico			x	x
Wrangell-St. Elias National Park and Preserve, Alaska			x	x
National Mall and Memorial Parks, Washington DC			x	x
Sleeping Bear Dunes National Lakeshore, Michigan			x	x
Badlands National Park, South Dakota			x	x
Cape Lookout National Seashore			x	x
New Orleans, Louisiana			x	x
Humboldt Redwoods State Park, California			x	x
Stećci Medieval Tombstone Graveyards	Bosnia and Herzegovina	Europe	x	x
The complex of the memorial Tjentište			x	x
Jajce			x	x
The archaeological site of Skelani	Italy	Europe	x	x
Colosseum Archaeological Park, Rome			x	x
Venice			x	x
Cinque Terre			x	x

Annex 2

Collective table presenting the transnational networks of natural sites that should be included in this initiative.

Site Name	Transnational network	Geographical extent	Number of sites	Other info	Reporting country
Cuatrociénegas Wildlife Protection Area	Ramsar	global	2331	Information Sheet MX734RIS & WHTL ¹ -1954	Mexico
Ring of Cenotes of Chicxulub Crater	Ramsar	global	2331	Information Sheet MX2043RIS & WHTL-5784	Mexico
Nichupté Mangroves	Ramsar	global	2331	Information Sheet MX1777RIS	Mexico
Chapultepec Woods	-	Hill and Castle, Mexico	1	WHTL-1273	Mexico
Huichol Route through the Sacred Sites to Huiricuta	-	from Nayarit to Chihuahua	1	WHTL-1959	Mexico
	MaB Biosphere Reserves	131 countries	727	https://en.unesco.org/mab	Mexico
	American Marine Protected Areas Network (NAMPAN)	Canada, the United States and Mexico	>1000	http://nampan.org/	Mexico
	RedParques	North America	23	https://redparques.com/	Mexico
Mesoamerican Reef Sistem		Mexico, Belize, Guatemala, and Honduras			Mexico

¹[World Heritage Tentative List](#)

Plitvice Lakes	Natura 2000&WPCA	EU	27312&13 terrestrial regions	https://www.iucn.org/commissions/world-commission-protected-areas	Croatia
Neretva Delta	Natura 2000	EU	27312		Croatia
Vransko Lake	Natura 2000	EU	27312		Croatia
Neretva Delta	Ramsar	global	2331		Croatia
Vransko Lake	Ramsar	global	2331		Croatia
	WCPA World Heritage Network	global	13 terrestrial regions	https://www.iucn.org/commissions/world-commission-protected-areas	Croatia
	Europarks	EU	56	https://www.europarc.org/	Norway
	Global Geoparks Network	global	169	https://www.visitgeoparks.org/	Norway
	Institute of Landscape Protection				Czech Republic
Garajonay National Park	Natura 2000	EU	27312		
La Gomera	Biosphere Reserve	global	727	https://en.unesco.org/biosphere	Spain
Lake Ohrid	Ramsar	global	2331		North Macedonia
National Park of Teide	Natura 2000&European Diploma of Protected Areas	EU	27312 & more than 60	https://www.coe.int/en/web/bern-convention/european-diploma-for-protected-areas	Spain
	Naval History and Heritage Command	USA		https://www.history.navy.mil/	USA
	American Battle Monuments Commission	USA		https://www.abmc.gov/	USA

	United States Department of Defense POW/MIA Accounting Agency	USA		https://www.dpaa.mil/	USA
	World Monuments Watch List	global	700	https://www.wmf.org/2022 watch	USA
	Emerald Network			<a href="https://www.coe.int/en/web/b
ern-convention/emerald-
network">https://www.coe.int/en/web/b ern-convention/emerald- network	Malta
Ghadira Nature Reserve	Ramsar	global	2331		Malta
Simar Nature Reserve	Ramsar	global	2331		Malta
Dakhla national park	-			UNESCO indicative list	Morocco
Lagune de Khnifiss	-			UNESCO indicative list	Morocco
Bel Ombre Treasure					Seychelles
Signal Hill Look out post					Seychelles
	Natura 2000	EU	27312		Portugal
	UNESCO Global Geoparks	global	169	https://en.unesco.org/global- geoparks	China
	FAO Globally Important Agricultural Heritage Systems	Asia & the Pacific		https://www.fao.org/asiapacific /es/	China
	UNESCO Grenadines Upstream Pilot Project	Grenada/Saint Vincent and the Grenadines		<a href="https://whc.unesco.org/en/inta
ssistance/2373/">https://whc.unesco.org/en/inta ssistance/2373/	Grenada

Mount Carmel Biosphere Reserve	Biosphere Reserve	global	727	Israel
Nature reserves inside the Mediterranean Sea				Israel
The Dead Sea				Israel
The coral reef in the Red Sea				Israel
Great Rift Valley				Israel
	Natura 2000	EU	27312	France
	Ramsar	global	2331	France

Annex 3

Table of examples with existing good practices and studies for the adaptation/resilience of cultural and natural heritage to climate change impacts.

Country	Existing good practices/studies	Authority	link
Mexico	<ul style="list-style-type: none"> - Study of present and future vulnerability of CNH to climate change impacts (2021-2024). - Official website Mexico for Climate Change. - Data Portal of the Climate Atlas of Mexico, Centro de Ciencias de la Atmósfera, UNAM: Data, models, and climate scenarios are also available through. - CONANP'S Natural Protected Areas Climate Change Adaptation Programs: 		<p>(www.cambioclimatico.gob.mx/)</p> <p>(www.ri.atmosfera.unam.mx:8586/geonetwork/srv/spa/catalog.search#/home)</p> <p>https://www.gob.mx/conanp/documentos/programas-de-adaptacion-al-cambio-climatico-en-areas-naturales-protegidas</p>

Georgia	- Vardzia Rock Cut Complex: Proactive Conservation and Monitoring System project.	https://www.europeanheritageawards.eu/winners/vardzia-rock-cut-complex/
Romania	<ul style="list-style-type: none"> - Proposal of certain adaptive solutions in the followings sectors: industry; agriculture and fisheries; tourism; public health; buildings and infrastructure; transport; water resources; forests; energy; biodiversity; insurance; recreation activities; and education. - Documents related to CC: the National Flood Risk Management Strategy, the National Strategy for the Prevention of Emergency Situations, and the National Disaster Risk Management Plan. 	
Albania	<ul style="list-style-type: none"> - Climate Risk Country Profile Albania - Effects of Climate Change on Heritage Ornela Cuci-Deputy Minister of Tourism and Environment, Albania - Adapting our City to a Changing Climate Vulnerability Assessment and Adaptation Action Plan for Tirana - Third National Communication of the Republic of Albania under the United Nations Framework Convention on Climate Change - Albania: "Building the Resilience of Kune-Vaini Lagoon Through Ecosystem - Based Adaptation (Eba) (Special Climate Change Fund) 	https://reliefweb.int/sites/reliefweb.int/files/resources/15812-Albania%20Country%20Profile-WEB.pdf https://ccich.gr/wp-content/uploads/2019/06/7.CUCI_.pdf https://www.giz.de/en/downloads/Report%20%E2%80%93%20Vulnerability%20Assessment%20and%20Adaptation%20Action%20Plan%20for%20Tirana%20Albania%20(2015).pdf https://unfccc.int/sites/default/files/resource/Albania%20NC3_13%20October%202016_0.pdf https://kunevain.com/wp-content/uploads/2018/09/EbA-Guidelines-English-compressed.pdf
Norway	- Adapt Northern Heritage project	The Directorate for Cultural Heritage Norway

Czech Republic

- Project summarizes the information
- All about climate changes in Czech Republic with also adaptation and methodology
- Czech adapt system for exchanging information on climate change impacts, vulnerability and the territory of Czech Republic
- Legislative framework from ministry of environment
- New challenge from university is focused on interdisciplinary cooperation. The aim of the projects is to combine knowledge and expertise from the humanities, social sciences, arts and technical and / or physical sciences. The call focuses on five topics and it is explicitly recommended to combine more topics in the project.

<https://www.kreativnievropa.cz/ke-stazeni-kategorie/publikace-a-studie/>

<https://www.klimatickazmena.cz/cs/>
https://www.mzp.cz/cz/zmena_klimatu

<https://www.phil.muni.cz/o-nas/organizacni-struktura/219915-oddeleni-vyzkumu-a-vyvoje/aktuality/vyzva-kulturni-dedictvi-a-globalni-zmeny>
<https://www.interreg-central.eu/Content.Node/STRENCH.html>
<https://www.jednapriroda.cz/en/>

Sweden

- Gammelstaden has developed a check list for house owners, in order to prevent damage from humidity and to monitor damages to the houses.
- Öland is working in different ways with the lack of water, desalination of sea water, for example.
- Guidelines for the inclusion of risk assessment connected to climate change impacts in the management plans for the WHS is being developed.
- Research is being conducted on reindeer husbandry in connection to climate change.
- Ordinance on authorities' climate adaptation work.
- Regionally the County Boards and municipalities develop climate strategies, often taking into account heritage values within the region.

Umeå University

The National Heritage Board, the Swedish Environmental Protection Agency, and the County Boards

<https://www.arcticcirc.net/our-projects/landscape-characterized-grazing>

Spain

- AdapteCCa
- The LIFE Shara Project

<https://www.miteco.gob.es/es/cam-bio-climatico/temas/impactos-vulnerabilidad-y->

- Global Change Monitoring Network in National Parks, an infrastructure for in situ data collection - meteorological-terrestrial and meteorological-oceanic - in the National Parks Network
- Designation of new marine protected areas
- Regarding cultural heritage, PNACC (2021-2030) plans to promote the knowledge generation in this area.
- PIMA's planning and initiatives (Planes de Impulso al Medio Ambiente -Environment Enhancing Plans)
- Fundación Biodiversidad (Biodiversity Foundation) and Oficina Española de Cambio Climático (Spanish Office on Climate Change) events
- Climate- ADAPT Webinar: Climate-ADAPT and UE 2021adaptation policies alignment
- European Environmental Agency and EuroMediterranean Centre events, and the "Polyfarming System Document": designing and implementing your own agri-food regenerative model
- Ecological Investigation Centre and Forestry applications (periodic reporting from the Responsible Publicity Observatory against Climate Change: "ECODES") initiatives.
- Other updated initiatives

The Autonomous Organization of National Parks, together with AEMET, OECC and the Biodiversity Foundation.

Ministry of Ecological Transition and Demographic Change.

adaptacion/casospracticosadaptacion_ncc_tcm30-523466.pdf

<https://adaptecca.es/casos-practicos>

<https://lifeshara.es/es/content/iniciativas-de-adaptacion-al-cambio-climatico>

<https://www.miteco.gob.es/es/red-parques-nacionales/red-seguimiento/default.aspx>

Republic of Moldova

- The Climate Change Adaptation Strategy of the Republic of Moldova and its implementation Action Plan until 2020 (a new Strategic framework for climate change adaptation will be developed)

The National Climate Change Commission chairs the Climate Change Coordination Mechanism (CCCM) in cross-sectorial coordination of all climate-related

<https://www.miteco.gob.es/es/cambio-climatico/temas/default.aspx>

		components. The Minister of Agriculture, Regional Development and Environment is the President of the NCCC and the Minister of Education, Culture and Research is a member of the Commission
North Macedonia	-	Development of a methodology to assess the climate change impact on cultural heritage and testing it on 3 sites in North Macedonia (a National Action Plan on risk assessment and adaptation has been proposed).
Morocco	-	Large consultative and inclusive approach to formulate the first iteration of the National Adaptation Plan.
	-	Development of a strategic plan.
Switzerland	-	A project to assess and quantify the long-term impacts of climate change on heritage (launched in spring 2021)
		The Federal Office of Culture
Poland	-	Development of Urban Adaptation Plans for cities with more than 100,000 inhabitants in Poland project (2017-2019) co-financed from the Cohesion Fund.
		Ministry of the Climate and Environment
Vietnam	-	Development of hydro-meteorological monitoring system in the heritage site to support collecting data and information effectively to make predictions about threats and risks.
		The Management Board of Phong Nha-Ke Bang National Park
	-	At the same time, the study and assessment on weather constituent, cave environment, outstanding geological heritage values have been implemented, contributing to mitigating the impacts of natural disasters on the heritage.
Portugal	-	Project 4CH
		Competence Centre for The Conservation of Cultural Heritage
China	-	Studies and surveys of the state of disaster prevention and reduction in China.
		ICOMOS China (Expert Committee)

	<ul style="list-style-type: none"> - It has also used active efforts to improve the theoretic framework, prepared the Introduction to Disaster Prevention and Reduction for Cultural Heritage, - and organized lectures and workshops to disseminate ideas and concepts, raise awareness, and improve professional capacity among frontier practitioners of cultural heritage, regarding disaster prevention and reduction. 	on Disaster Prevention and Reduction for Cultural Heritage)	
Grenada	- Climate Smart Cities Project (in progress)		
Iran	- Studies are initiated to include CC impacts on CNH sites within their management plans and are to be approved before any implementation.		
Austria	<ul style="list-style-type: none"> - The Monument Protection Act, - The Austrian Federal Guidelines for Building Culture and Management Plans for Austria's World Heritage Properties and related local and regional legal provisions (Austria as a federal state). - 4th Building Culture Report - The English summary (goal: Implement architecture that reduces CO2 emissions and protects the soil) 		
France	<ul style="list-style-type: none"> - ADEME supports local authorities in the implementation of climate change adaptation actions, through methodological guides and collect of experiences - LIFE NaturAdapt project (2018-2023) aims to adapt nature protection to the challenges of climate change in Europe - The French National Adaptation Plan for Climate Change 	<p>French Agency for Ecological Transition</p> <p>Réserves Naturelles de France</p>	<p>https://www.ademe.fr/expertises/changement-climatique/passer-a-l'action/comment-sadapter-changement-climatique/publications-outils-collectivites-territoriales</p> <p>https://naturadapt.com/</p> <p>https://www.ecologie.gouv.fr/sites/default/files/2018.12.20_PNACC2.pdf</p>
Malta	<ul style="list-style-type: none"> - Sites included in the Megalithic Temples (UNESCO WHS): installation of protective shelters. - Environmental monitoring and condition assessments at all the sites (ongoing) - A number of studies on various climate related issues have been and are being carried out by the University 		

	of Malta as well as some environmental NGOs dealing with climate changes impacts on natural heritage.		
USA	<ul style="list-style-type: none"> - Vulnerability Risk Assessment (ongoing) - The National Park Service Climate Change Response Program (CCRP), established in 2010, which advances efforts to address the effects of climate change across the 423 sites that make up the U.S. National Park Service system. - Planning for a Changing Climate and Resist-Accept-Direct (RAD) – A Framework for the 21st-century Natural Resource Managers - RESOURCE STEWARDSHIP STRATEGY SUPPLEMENTAL GUIDANCE: INTEGRATION OF CLIMATE CHANGE SCENARIO PLANNING INTO THE RESOURCE STEWARDSHIP STRATEGY PROCESS, February 2020 (nps.gov) - Planning for a Changing Climate: Preparing Parks for Change - Office of Communications (U.S. National Park Service) (nps.gov) - RAD Framework: Resist-Accept-Direct (RAD) - Climate Change (U.S. National Park Service) (nps.gov) 	(nps.gov)	
Bosnia and Herzegovina	<ul style="list-style-type: none"> - Climate-specific initiatives on natural heritage and building sector 	Ministry of Physical Planning, Civil Engineering and Ecology of Republic of Srpska (RS), BiH Climate Change Committee	http://www.unfccc.ba/
Italy	<ul style="list-style-type: none"> - Colosseum Monitoring plan of an archaeological area in the urban historic center. Identification of sustainable management procedures, preventive emergency situations, early warning system through mitigation strategies. Satellite monitoring (Cosmo-SkyMed interferometric techniques) to obtain information on deformations of the ground, structures and buildings - Venice Evaluation of Climate Change impact on the 90 bell-towers of the city. Satellite remote sensing combined with traditional in situ techniques to check the 	Ministry of Culture - Soprintendenza Speciale per il Colosseo, il Museo Nazionale Romano e l'Area Archeologica di Roma Ministry of Culture - Soprintendenza Archeologia, belle	

structural health of these particular architectures, characterized by high IFoad levels.

- - Cinque Terre Landscape recovery of an abandoned agricultural terraced complex. Sustainable technologies, renewable energy sources and water / wastewater treatment in a delicate landscape-environmental context. Terraces make space for cultivation and serve as a bulwark against hydrogeological collapse. Case Lovara is now an active agricultural farm in a national protected area.
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arti e paesaggio per il
Comune di Venezia e
Laguna

Fondo Ambiente
Italiano – FAI (Italian
Environmental
Foundation)